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FACTORY COSTS

A Work of Reference for Cost Accountants and Factory Managers

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BY
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PREFACE

The present volume treats of the principles and methods of modern cost accounting. It is designed primarily for the public accountant and the constantly increasing number of general accountants who are in charge of, or interested in cost-finding systems. It should be of much direct value to the owners or officers of industrial institutions, to works managers, superintendents, and department heads. For these, some few of its chapters, not treating specifically of cost accounting, were especially prepared.

Those unacquainted with the author may ask by what right he assumes to speak with authority on the subject of cost accounting. For his justification he may say that the book is the result of nearly twenty years' personal experience as a public accountant, the greater part of which was spent in the installation of cost systems and the general modernizing of factory accounting methods. In the course of this experience the author had opportunity to scrutinize the accounting methods of over one thousand manufacturing concerns throughout the United States and Canada. It is true that in the majority of cases this scrutiny was brief, but nevertheless it was sufficient to disclose the salient features of the plans pursued.

In the preparation of the volume the author has utilized good forms, good systems, and good ideas wherever they were found. In some cases he has not given credit for these "borrowed values"—not from any desire to withhold credit but

only because it was impossible to discover to whom credit was due. Wherever it could be done, credit has been given.

The forms presented are for the most part those designed by the author for use in factory systems installed by him. He does not, however, claim to have originated all these forms, as they have in many cases been modified from forms in use.

Neither does the author make any claim to originality in the systems of cost finding presented. For the most part these systems have been gradual outgrowths, modified by particular requirements and by the experience of cost accountants, until in attaining their present form they have become common property.

The systems of cost finding discussed in the present volume cover all those in general use. Systems may be found bearing different names, but on analysis they will—for the most part at least—be found to fall under one or another of the classifications of the present volume. The endeavor has been, as far as possible, to avoid the introduction of too many names covering the same, or similar systems. The titles used are those best known and most generally applied to the methods they designate.

It is hoped that the volume may be of real assistance to cost accountants and others interested in the finding of production costs. The work is largely non-technical, but it will be of none the less value to the accountant for this reason, and it may be of greater value to those who, while not engaged in cost accounting work, are engaged in work requiring cost accounting for its safe, proper, and profitable conduct.

FRANK E. WEBNER.

198 Broadway, New York.
September 1, 1911.

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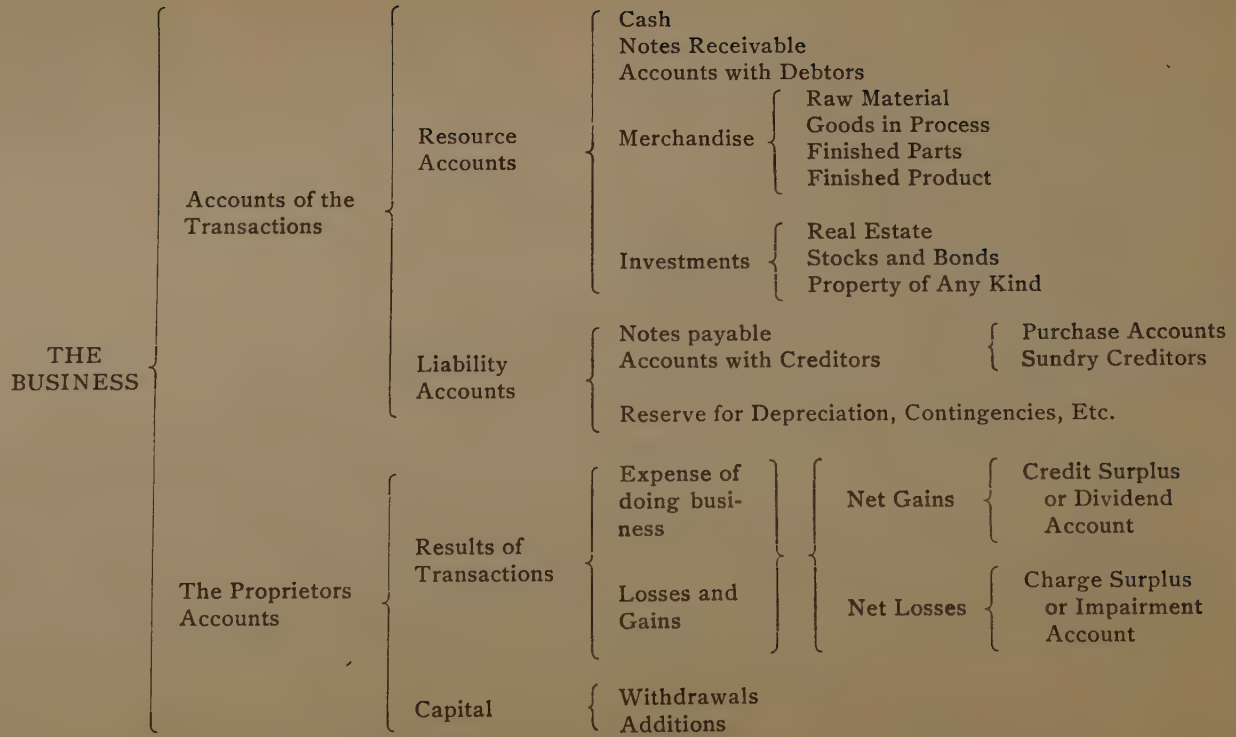

FIGURE 2—Abridged Chart showing the general relations existing between a business and its accounts.

FACTORY COSTS

PART I.— FACTORS AND CONDITIONS.

CHAPTER I.

ACCOUNTS AND COST ACCOUNTING.

§ 1. Organization.

The slogan of present-day industry is efficiency. There is no efficiency without organization. A highly organized selling force can move an article of inferior merit where a poorly organized force has failed with a better article. In like manner a well-organized factory, under capable management, its different parts carefully harmonized, its human frailties minimized, its operations controlled by an efficient system of cost records, can produce better goods for the same cost, or the same goods at a lower cost, than is possible for a poorly organized competitor.

To secure the greatest efficiency, factory organization must extend consistently throughout the entire fabric. In military operations success does not rest with the fighting organization alone. The engineering corps, the commissary and the hospital departments, are all important adjuncts and contribute largely to the success or failure of a campaign,—so largely that the collapse or defection of one of these subsidiary factors might bring disaster upon a whole army. Similarly the organized system of a business should include in its harmonious scheme every contributing element,—the general management, department heads, office force, the selling corps, the purchasing department, and all labor, productive and non-productive, down to the lowest helper. Every one

must do his part, and for the best success must not only do it well but do it so that it will "intermesh" properly with the general industrial mechanism.

To build up an organization efficient to its ultimate economic possibilities is the work of the efficiency engineer. "He considers a business as an intricate machine. He analyzes each process into its ultimate units and compares each smallest step of the process with an ideal of perfect conditions. He then makes all due allowance for rational and practical conditions and establishes an attainable commercial standard at every step. Then he seeks to obtain continuously this standard, involving both qualities and quantities—the interlocking or assembling of all these prime elements in each process into a well built, smooth running machine; and when there are, as usual, several processes in each department and several departments in the business, all the departments as well as all the processes must be co-ordinated, so that the machinery of the whole business works with equal smoothness. * * *

"In scientific management, therefore, results are predetermined. Before the work is commenced, it is determined not only as to what shall be done, but how it shall be done, when it shall be done and what it shall cost."*

§ 2. Place of Records in Organization.

Not infrequently one comes in contact with successful men of affairs who practically carry the records of their business in their heads. Such men have wonderful memories for dates, numbers, and amounts, but even more astonishing is their reckless disregard of the true requirements of business, and their shortsightedness in loading their busy brains with details which could be handled far better by comparatively inexpensive accountants.

Times without number the expert accountant is called upon to bring order and meaning out of almost unintelligible

* Brandeis, "Scientific Management," pp. 17, 18.

masses of figures resulting from the attempt of the owner or manager to carry too many of the records of the business in his head. Such a business, handicapped by the conditions, labors along heavily and with seriously impaired efficiency, until too often the burdened memory of the accountant-manager refuses to longer carry its "overload." Then its records are blotted by mental failure or obliterated entirely by the hand of death, and the business is left hopelessly entangled in a mass of defective and almost meaningless data.

Even where methods are less archaic, the accounting system but seldom "measures up" to the possibilities. "Dead time," "non-productive labor," "a necessary evil," etc., are expressions often used to characterize bookkeeping work and, where used, are generally justified by the results or lack of results obtained from the records. "The truth is that a more extraordinary jumble of figures that have no connection with each other, and no significance in relation to any particular job, cannot be found than the so-called expense accounts of most manufacturing businesses. Very few persons, even of those who use them daily, realize what they mean practically. No one, commonly, has the least idea how they are likely to be affected by an expansion or shrinkage in the volume of work, and if so affected, what deductions can be safely made from their rise or fall."*

There is no excuse for such conditions. There can be no effective organization and system or any high degree of efficiency without accurate, adequate, and properly used records. Statistics show that nine out of every ten business failures are the direct result of ignorance of the real conditions which would have been revealed by a proper accounting system.

It does not always follow that a man who fails in business has not been selling at a profit. Any shrewd manufacturer knows the danger in overbuying, or in having too many obli-

* Church, "Production Factors," p. 13.

gations maturing simultaneously, or in accepting more orders than he has capital to carry or capacity to properly fill. These and other analogous "danger centres" have brought many a well-meaning business man to shipwreck upon the financial rocks—disasters due to the absence of, or ignorance of the instructive details of a monthly balance sheet.

Accurate and efficient records are quite as important to a business as are charts and compass to a ship at sea, showing the location of the shoals which menace disaster, indicating the channels in which the water is deep and safe, and pointing surely and steadily the course to be followed. In any large and really successful business the accounting department is looked upon as one of the most important factors of success, and the larger and more successful the operations of such a business, the greater the pains to maintain an adequate and effective system of accounts.

§ 3. Place of Cost Accounting.

Cost accounting is distinctly a part of factory accounting. A cost accounting system, as ordinarily understood, is a system of factory records which, properly adjusted to the general system of factory operations and accounting, enables the manufacturer to ascertain with at least fair accuracy the production cost of his goods and the constituent elements which make up this cost.

Among the accounts of the modern factory none occupies a more important position than do the cost accounts. They do much more than show the mere cost of goods produced. A cost system which discloses nothing beyond the fact that a certain unit of production costs a certain amount of money, may serve a highly useful purpose, but it falls far short of its highest usefulness. It should also show *why* the unit of production costs the amount that it does.

Cost accounting is a comparatively modern development. As a recognized art it is hardly a generation old. In the

early days of cost accounting, the cost accounts were usually kept separate and distinct from the general accounts, under the belief that the difference of standards was irreconcilable. Modern accounting has shown the fallacy of this view; has shown the clear and close relations between cost accounts and the general accounts, and has devised working methods by which the cost accounts become an integral part of these general accounts. If the cost records are not part of the general accounting system—if they do not "match up" with the general books—they may supply data of very considerable importance, but they fail to attain their highest usefulness and value.

§ 4. Ends Attained by Cost Accounting. (a) Cost Finding.

The first and most obvious end of factory cost accounting is the determination of production costs. This is the simplest and necessary resultant of any correct and properly operated system of cost accounting.

The mere determination of production costs is immensely important and well justifies the installation of a cost accounting system. With it, price-making can be safe and intelligent. Without it, the conduct of the sales department must be more or less haphazard and unsafe. The average manufacturer does not know what his goods cost him. A prominent trust official is reported as saying that when, before the formation of the trust, he was at the head of an independent factory, he used to sometimes wonder how his competitors could afford to take contracts at the figures they did. When the books of these concerns were opened to his inspection by the consolidation, he discovered that these competitors had never known even approximately the cost of manufacturing their goods and as a result of the system of "cost guessing" this entailed, they not infrequently took contracts at an absolute loss.

Illustrations of the truth of this statement are familiar to every accountant. A recent instance may be cited of a corporation of national reputation dealing in dairy pro-

ducts, which found one of its competitors underbidding it sharply on certain lines. An examination of its records showed conclusively that the corporation's figures were as low as could safely be made. A polite note sent to the competitor called attention to this fact and suggested an investigation. As a result, on the next competition the figures of the competing concern exceeded those originally quoted by the corporation. As a matter of fact the competing concern had been selling the particular products at a loss, simply because it did not know their actual cost.

The advantage that a knowledge of production costs gives a manufacturer when making prices is easily seen. His prices are made intelligently. He can cut to the lowest possible figure when necessary without fear of incurring losses, or if the conditions justify a loss on certain lines, he will know exactly how far he can go without exceeding the justifiable and intended loss. On the other hand, without a knowledge of costs he is absolutely in the dark in fixing prices—so much so that his only safety lies in prices so high that he is absolutely sure he is above production costs—a happy-go-lucky method of pricing that, while safe from the standpoint of direct loss, is not, in this highly competitive age, conducive to large success.

When a producer stakes his chance of loss or profit upon a guess as to what his goods cost him, he becomes a gambler. He not only jeopardizes his own interests, but the interests of his competitors—who must strive to meet his frequently impossible prices—and the interests of the trade at large, which he is helping to demoralize by his "unfair prices." When he fails, the whole industrial fabric is affected by both the act and record of failure, and he not infrequently carries down with him other institutions, entailing heavy loss upon hundreds and even thousands of people who did not even know that their interests were related to his.

§ 5. Ends Attained by Cost Accounting. (b) Reduction of Costs.

Production cost is but one feature of a cost system, though frequently the only feature recognized and developed. Beyond this, the "analyses of costs, operation by operation, to be secured from an efficient cost system, supply the manager with invaluable data from which to work in *reducing* costs. Nor does their effectiveness stop here. If it is decided to start a campaign to increase the efficiency of the factory force and to eliminate the inefficient men, then the individual records of the men will be secured from the cost records. In large bodies of workmen, a steady and intelligent campaign along these lines will work wonders."*

An efficient cost system will to a limited degree operate automatically to reduce costs, from the mere fact that under its close supervision and its full exposure of waste and inefficiency, employees work better and are more careful of material and mechanisms. Beyond this it will, as time proceeds, bring to the attention of the management many conditions in the establishment not previously considered, or perhaps not known at all.

Thus, excessive costs are discovered and forced into notice, as are also wasteful leaks or bad conditions which make costs higher than they should be and which when removed result directly in increased efficiency with its resultant of decreased costs. A process is simplified here; the amount of material is reduced there; small wastes of labor and material are stopped; overhead expenses are cut down; related operations are brought into closer juxtaposition; and finally there is brought about a desirable efficiency and a disciplined workmanship which insure the maximum of results with the minimum of cost.

An adequate cost system also indicates fluctuations in production costs and show just where these variations take their rise. Frequently the causes of these fluctuations are be-

* Carpenter, "Profit Making Management," p. 20.

yond the power of the management to remove, but, on the other hand, it is often found that they can be removed or regulated; this resulting in more uniform production prices and a greater general economy of production.

§ 6. Ends Attained by Cost Accounting. (c) Increased Efficiency.

Increased efficiency is, from the practical standpoint, so synonymous with decreased costs that but little need be said on this phase of cost accounting results. As already stated, the introduction and operation of a good factory cost system acts in itself to stimulate employees and directly increase their efficiency. Beyond this, the cost system in its operation indicates the consumption of material, the time and cost of every labor operation, and the performance of every separate machine, thus enabling the management to judge whether men and machinery are measuring up to the proper standards of efficiency and whether adequate results are being obtained from material.

It is obvious that the highest efficiency is not possible unless any failures to attain this standard are known. Such failures the cost system will discover. It primarily indicates costs, but even in this it affords an index of efficiency, for an increased cost is an almost unfailing indication of failure in effort or operation.

When efficiency failures are suspected or known to exist, the cost records will show just what and where these failures are. The efficiency failure may be found in slow or careless work on the part of employees, or in an excessive consumption of material, or in defective operation of machines; or it may be due to accidental interruption to the usual or proper routine of production. Whatever the cause, it will be shown by the cost records.

The proper use of a cost system will also serve to equalize the output in the various departments and afford a basis upon

which to judge the comparative efficiency and desirability of workmen. To the majority of these employees it is an unmixed good, giving a fair and just estimate of their abilities and making them largely independent of the whims and caprices of foremen. What they do is a matter of recorded fact, not ordinarily open to attack, and enabling the establishment of a merit system equitable and adequate because it is based on actual performance. A more potent factor for increased efficiency could hardly be devised.

§ 7. Where Cost Accounting Is Needed.

Cost accounting is not necessary, nor is it possible in every manufacturing establishment. The shop working but a single man does not need a formal system of cost accounting. Also businesses exist in which the nature of the processes or operations employed are such as to make cost accounting, as ordinarily understood, practically impossible. Costs can be found, but the difficulty and the expense of the operation are so great as to overbalance the resulting advantages. In such cases the approximate cost of production must be ascertained by some general system of averages. The results are not accurate but closer costs are not economically possible.

In some cases cost finding is not for the time important, as in the manufacture of a new specialty so successful as to tax the capacity of the factory to its utmost to handle orders. Prices are far in excess of any possible costs and there is no pressing need for a close knowledge of manufacturing expense. Money may be lost by reason of excessive costs, but the margin of profit is so large that the loss is not disastrous. Later, when the inevitable conpeting article puts in its appearance and cuts into both orders and prices, the subject of production costs becomes a live and important one and an efficient system of factory costs is greatly desired.

Another somewhat analogous case where cost finding is not absolutely essential, is that of the manufacturer whose

product is a practical monopoly. His profits are made not so much in manufacturing as in charging—not so much in a legitimate increase of selling over cost prices as in the wide margin of profit accruing to him through invulnerable patent rights, exceptional natural conditions, purchased friendship, or controlled special machinery. Such a manufacturer is "gunning for large game," so to speak, and the various cost reductions made possible by a more or less intricate cost system, petty in themselves, though large in the aggregate, are not necessary to his success, and do not appeal to him as worth while. As a matter of fact, such a manufacturer might usually farm out his work to properly managed factories at a cost considerably less than that of his own production.

It sometimes happens that a factory has grown from a small beginning to an enormous output, its growth being marked by numerous additions to the original plant. In such case the additions are usually added from time to time as the necessity arises, without any central plan or harmonious arrangement. The route of the product through such a factory is frequently intricate and involved, and the related operations are not closely "coupled up." Under such circumstances a cost system, though badly needed, is difficult of installation and operation, and its results are discouraging to the management. The only proper solution of such a problem is to remodel or completely rebuild the plant, or secure a new and more suitable building in some other way, and then instal an adequate cost system. The conditions are too unfavorable for the satisfactory operation of either a business or a cost system.

Just when in the growth of a factory a cost system should be installed is a matter to be determined by the particular conditions. Usually when the employees are few, no formal system of cost finding is desirable, as the cost of its installation and operation would be more than its value to the business. If, however, the business grows, a time will come when a cost system is not only desirable but essential if the busi-

ness is to be conducted intelligently. Somewhere in the upward progress of the business the necessity will arise: the manufacturer will find impossible the close supervision of the factory that formerly put him in possession of all necessary information. His increased output will require more careful pricing and a closer knowledge of costs. A cost system must then be installed that will keep him informed as to the details of his business and take the place of the personal touch which he can no longer maintain.

Broadly speaking, it may be said that every manufacturing concern which conducts its business on a more or less narrow margin of profit, needs a close knowledge of production costs if dividends and surplus are to be maintained. Beyond this in every factory where it is economically possible, some system of cost finding will be found advantageous. The greatest need for a well-equipped system of cost finding is, however, found in plants producing staple articles the output of which is large and the selling price of which is fixed to a greater or less extent by competition. Here a small fraction of a penny in the unit cost of production may mean the difference between success and failure, and this close control of costs can only be maintained through the operations of a first-class cost system.

It must always be borne in mind that cost finding is but one function of a cost system. As already stated, it serves as a graphic presentation of the conditions existing in the factory. For this reason cost systems are frequently installed, not so much to discover the costs of product, but, as a matter of prime economic importance, to discover whether these costs are being kept down to the lowest possible figure, or at least to a figure that will permit of profitable sales at the prices that must be met.

§ 8. Adaptation of Cost Systems to Special Needs.

A factory which produces but a single line needs to know its cost of production just as accurately as a factory producing

a hundred different articles. The costs of the former are, however, much more simple of attainment as a rule and a much less complicated system of cost accounts is required. In other words the system must be adapted to the business. The "ready-made" system will but rarely fit any business.

As a matter of fact there are scarcely any two lines of production or any two factories in the same line which are precisely alike in so far as cost finding is concerned. Each has its own special problems which must be intelligently solved in the application of a cost system. A cost system is as urgently needed in the manufacture of optical goods as it is in a machine shop, but emphatically the plans evolved for cost finding in the machine shop will not serve to find the costs of lens grinding.

Here is where the services of the specialist are required. The broad principles of cost accounting apply, but their special adaptation is a matter for trained and intelligent accounting. The problems of the particular business must be studied and understood, and the system of cost finding be devised with a special view to complete and adequate provision for these problems. The designer of a cost system should be thoroughly familiar with every phase of cost accounting and with every possibility of adaptation to special needs.

§ 9. Inaccurate Costing.

The day of cost guesses in the factory is over—at least for the manufacturer who expects to do anything worth while. Formerly it was not uncommon to estimate costs by the rule of thumb method, the manufacturer perhaps saying, "Well, the rough castings weigh 480 lbs. and average 4 cents per pound. Our lathe hands are getting $3 a day, drill press men $2.75, etc. We can turn the job out in a month's time and the productive labor will cost us on the finished machine about $200 all told. The assembling will cost about $125. Add 15% to this to cover non-productive work, and 25% for profit, and I guess we can sell the machine for $500.

In a small concern where the cost price is pretty well known, and in a larger concern where the selling price is far above any possible cost, ignorance of exact costs may involve no disastrous results. The condition is, however, on a parity with a carpenter without a square or the machinist without a gauge. Results may be produced in spite of the untoward conditions, but they are not the best results and sometimes they lead to disaster.

Nor, speaking generally, is the cost system adequate which must wait for its results until an inventory is taken at the end of the fiscal period. In many enterprises today, the profits and losses are not known until the end of the fiscal period when an inventory is taken and the books are closed. Even then the accuracy of the result is entirely dependent upon the accuracy of the inventory, and this under ordinary book-keeping conditions is always a matter of uncertainty as there is no means by which it may be proved.

Not only are inventory results incapable of verification under the ordinary system, and therefore dangerously liable to inaccuracy, but—deferred to the end of the fiscal year—they frequently come too late to be effective. Sales must be made when the goods and the times are ready, but the cost of these goods is not yet known. One line of product may have run far and away above estimated costs. Another may have fallen considerably below. Possibly these variations may balance each other. Frequently, however, when figures are quoted blindly, serious losses occur against which there is no offset, and even where there is an offset it were a great deal better to devote the offsetting profit to dividends rather than to the balancing of an unnecessary loss.

The modern manufacturer must have a cost system which is primarily accurate. Beyond this, costs must be determined at such nearly recurrent periods—usually at the end of each month—that a close and effectual watch may be kept on cost fluctuations. Daily reports must keep the manufacturer in touch with current conditions.

The utility of such a system requires but little comment. It places a graphic chart of the production department and its operations before the manufacturer's eyes. It gives him an exact knowledge—both synthetic and analytic—of his manufacturing costs, enables him to foresee and avoid possible losses, and puts him in a position to conduct the business with an intelligence and assurance that would otherwise be absolutely impossible.

§ 10. Installing a Cost System.

For a successful installation of a cost system the first requisite is an accountant experienced in cost accounting and in the installation of cost accounting systems. This is essential if the installation is a large one, for a cost system should be like a well-built machine—constructed for a definite purpose, producing anticipated and clearly defined results, and working surely and smoothly. All this it can be, and can do if the system is well devised in the first instance, and then placed in charge of the right kind of men—men who will give their earnest energies to the cause and not "back and fill" in the harness.

When the system is once fairly established in a business of such size as to employ a force of clerks in the cost department, one man should be placed in supreme control. Usually this will be one of the regular accountants of the establishment, though in some cases special accountants are employed. The man in charge, whether a regular or special employee, must have full authority to adjust small differences in his own realm and to a reasonable extent he must have authority to enforce the proper observance of cost system requirements in the producing departments. This authority must, of course, always be exerted through proper channels—i. e., through the foremen and never with any attempt to pass over them.

The man in charge of the new cost system must be one who can and will do things, as far as possible, along the lines

laid down for him, and not one ever ready with a hundred and one excuses and reasons why certain desirable things cannot be accomplished. The system *if properly devised* can be made a success and it is his place to make it a success. If obstacles arise that he cannot get around, he must get over them, or get on the other side some way or other and get there without too great a cost. He must recognize the fact that the installation of a new system of any kind is uphill work, and that far too many of those concerned are apt to place obstructions in the way rather than lend a helping hand.

It is hardly necessary to say that the man placed in charge of a new cost system should be possessed of much tact, and, if a regular employee, be possessed also of an assured status in the factory. He should be a man who can secure the cooperation of his subordinates and the more or less cheerful acquiescence of the employees generally in the requirements of the system. The importance of this cannot be overestimated.

In the cost department the moral support of every member of the force should be given as a matter of course, and the clerical force generally should be instructed to either speak well of the innovation, or, save as necessary to their regular duties, not speak of it at all.

§ 11. Opposition to Cost System.

When a cost system is installed, as already intimated, various difficulties are encountered. Employees almost invariably oppose its introduction, as the new system may mean a curtailment of privileges, closer supervision, and more effective work than before,—all matters directly advantageous to the plant but not always so pleasant for the men. Also the clerical force of the accounting department may resent the innovation, and not give the new system the hearty support it requires and should receive.

Beyond this, it is a foregone conclusion that some points of the system as installed will require revision in the light of

developments, and the unexpected results, failures, or friction in the operations of the system before these changes are made, frequently arouse the distrust of the management. Also it often happens that unsuspected weaknesses of factory organization and operation are disclosed by a scientific cost system, and the discovery excites hostility on one hand and incredulity on the other. Or the system will indicate an entirely different state of affairs from that which the management had supposed to exist—something quite unbelievable to those in authority. Or again, conditions which, though known to exist in a general way, have been ignored, are emphasized and so sharply indicated that their existence cannot be longer overlooked.

All this results in more or less trouble for the new cost system. Under the most favorable conditions, opposition—more or less open—is to be anticipated. Frequently the opposition is real and serious, and if the manager upon whom devolves the responsibility for the introduction and successful operation of the system, is lacking in tact or easily discouraged, he would better delegate the work to some persuasive, strong-willed, and enthusiastic subordinate, and then himself keep hands off and look only for results, and not expect these too soon.

It is not to be expected that the manufacturer will postpone or decide against the introduction of a cost system in order to avoid the inevitable opposition or spare the sensibilities of his men, but it is obviously wise to avert opposition as far as possible and to avoid antagonizing the men. The new system should, therefore, be diplomatically launched and carefully guided.

The question of unionism is sometimes involved in the introduction of a new cost system. The general opposition of the unions is not, however, antagonistic to modern methods. As stated by Mr. Brandeis,* "Unionism does not prevent the

* "Scientific Management," p. 65.

introduction of scientific management. * * * It will always require tact and patience to introduce radically new methods, whether the persons to be affected are organized or unorganized workers, or are those 'higher up.' Tact and patience are essential to the introduction of scientific management in any business, but the experience of those who have been engaged in the introduction of scientific management in various businesses, in some of which closed, in others of which the open shop prevailed, clearly establishes that unions have not presented any obstacle to the introduction of scientific management as soon as the nature and purpose of the changes proposed were understood and the good faith of the management was apparent."

§ 12. Operation of the New Cost System.

"The machines that are first invented to perform any particular movement are always the most complex, and succeeding artists generally discover that with fewer wheels, with fewer principles of motion than had originally been employed, the same effects may be more easily produced."*

So it is with the new cost system. Too much cannot be expected at first. The system must have time to "find itself." Complexities must be smoothed out and friction eliminated. If at the end of six months results are showing fairly well, the system should be considered successful. In large plants even so long as a year may elapse before the best results are attained.

Finally, the cost system must not be expected to do too much in itself. It will disclose facts and costs upon which action can be based, but when it has done this it has done its part. It has "thrown" the proper signals. If the engineer—who in this case is the manager of the works—disregards the signals, he alone is responsible. The system can do no more.

* Adam Smith.

CHAPTER II.

THE HUMAN ELEMENT AS AFFECTING COSTS.

§ 13. Importance of the Human Element.

Business success depends upon the proper co-ordination of many factors. The human factor is the most important of these. It is also the most difficult to harmonize and adjust. From top to bottom of the industrial mechanism the frailties and peculiarities, the instincts and prejudices of the human element are continually encountered, developing friction and causing unexpected and troublesome complexities. A discussion of cost accounting would hardly be complete without a consideration of the effect upon it of the many and varying phases of human idiosyncrasy which it must encounter.

§ 14. The Management.

The consent of the management is, of course, a first step towards the installation of a cost system. Where it is really needed the advantages of a good cost system are so direct and so obvious that objections to it on the part of the management would hardly be expected. As a matter of fact, hesitancy, procrastination, and objection commonly characterize the managerial heads when the subject of a cost system is broached. "To these the very word 'organization' implies something mysterious—something big and certainly something expensive. The idea of 'organization' is not compatible with the idea of economical management. To these the idea of 'system' is indissolubly linked with 'red tape.' 'System' to them means additions to their clerical force, and additions to their clerical force mean additional dollars spent upon 'non-producers.'

"They will refuse to admit the advisability of systems sufficient to care for their heavy factory interests, and yet they have sufficient intelligence to keep up their general accounting system."*

The objections urged against the introduction of a cost system are many. To the professional accountant or to the advocate of the cost system, the manufacturer will declare in good faith that he is in close touch with every detail of his business and particularly with the cost of his product, and that the installation of a cost system would be a work of supererogation.

Another manufacturer will say that he contracts for his raw materials on an annual basis and that for this reason prices of material do not fluctuate with him; that he employs his shop hands on a piece-work basis entirely and therefore knows his labor costs to the fraction of a cent, and that his overhead expense is quite readily distributed over his product at a given percentage of labor cost.

Yet another manufacturer will say his records are kept so that his costs for material, labor, and expenses in each department are clearly shown and that accurate estimates can therefore be made of the cost of any individual article or product *when these are needed.*

Yet again, a manufacturer taking a less vulnerable position, declares that he has a specialty or enjoys such exceptionally favorable conditions that competition is practically eliminated; that he knows he is making money and is satisfied with the results as they are, and that the estimation of costs to the fraction of a cent is of no interest to him.

And so the argument runs. Human nature prompts the manager to combat any intimation that his plans or arrangements are not of the best, and yet in the inner councils of his staff puzzling losses, unexplained shortcomings, and profits that should have been made but were not, are constantly com-

* Carpenter, "Profit Making Management," p. 11.

ing up for perplexed discussion,—conditions which should be an all-sufficient reason for better accounting or for a more intelligent application of that already in use.

Progressive management is a *sine qua non* of continued success in modern manufacturing. Conditions in the industrial world are constantly, and, at times, rapidly changing and, unless factory conditions keep pace with the changing requirements, the relegation of the non-progressive factory to the industrial scrap heap is but a matter of time.

Even where managerial inertness does not take the form of opposition to the introduction of a cost system, it may yet be fatal because of its reluctant adoption of modern methods. An illustration of this is found in the history of a certain implement concern, now defunct because of the "antagonism of the trust" as its management explained, which grew from a very modest beginning to one of the foremost concerns of its kind. In spite of defective physical conditions the concern made profits in large and increasing volume until the utmost capacity of the inadequate, crowded and ludicrously scattered quarters had been reached. The management apparently rose to the emergency. An option on a desirable location in the outskirts of the city was secured, a new factory building was projected, and the installation of a first-class modern cost accounting system was agreed upon.

This was promising, but at this juncture the head of the concern—a penny-wise manufacturer of the old school—forbade the purchase of the new location until a purchaser, or at least a tenant, had been secured for the building they were in. This was not easy, and while waiting to "catch" their tenant, the option on the new site expired and could not be renewed. Meanwhile in anticipation of the new facilities orders in excess of the capacity of the concern had been booked, and the failure to fill these within reasonable time caused much discontent among its customers. At the same time serious com-

petition arose and the concern, heavily handicapped by its unfortunate environment, could not hold its own.

Business began to fall off and all thoughts of the new building were given up. An attempt was, however, made to establish a scientific cost system in the old plant. Even this was not successful owing to the extremely unfavorable physical conditions. The operations of the partly fledged system did, however, show some very surprising facts, as for instance, that the indirect labor costs due largely to trucking and repeated handling of parts, was almost double the cost of direct productive labor. It also showed the prevalence of lax methods as well as bad physical conditions all through the plant. It, indeed, interpreted the handwriting on the wall and indicated as nothing else could have done the speedy downfall of the plant—a downfall that did not as a matter of fact require any assistance from "the trust."

A cost system once installed naturally does not encounter the active opposition of the management, but it is frequently injured almost as seriously by captious criticism or an almost hostile indifference. This is an absolutely indefensible position. The installation of a cost system should not be authorized until the management is either convinced of its merits or willing to give it a fair trial. Once decided upon, there should be no hindrance and no wavering or turning from the task. The installation of a new system in a large industrial plant involving even slight changes in the habits and practices of hundreds of men, is, as already suggested, bound to encounter more or less serious opposition—an opposition that cannot as a rule be overcome successfully save with the encouragement, support, and active assistance of those in control. As a matter of good practice and good business, the new system should have the warmest and heartiest support of every official. Particularly should this support be warmly active in the beginning and until the successful operation of the new system has become a mere matter of routine.

§ 15. The Superintendent.

In the thoroughly modern shop the superintendent is conversant with every process and with every part of every operation. This involves a knowledge of the cost of each process or of each operation and also the cost of each element or section and in turn the cost of the completed whole. It is the duty of the superintendent to keep a general supervision over the factory in its entirety, increasing efficiency and decreasing costs wherever possible.

With such duties the full co-operation of the superintendent and of his immediate subordinates is essential to the efficiency of any cost-finding system. If the superintendent is opposed the system is likely to prove a failure. If he is lukewarm, the difficulties of successful installation and operation are great. If, on the other hand, he is enthusiastic and determined to produce the best possible results, the success of a well-adapted system of cost finding is practically assured.

The superintendent's support should not be hard to enlist. If he is capable he will readily appreciate the value of an efficient system of cost accounting. If in any case the superintendent is found to be opposed to the introduction of a cost system and his opposition cannot be overcome, either the installation had better be deferred to a more favorable season, or had better be preceded by the employment of a new and more progressive superintendent.

§ 16. The Foreman and His Men.

It is a foregone conclusion that both foremen and workmen will, to some extent, resist all attempts to secure accurate data concerning labor operations. A good cost system properly operated will tend to prevent shirking, reduce dead time, and increase efficiency, but in doing this it will demand greater effort and more steady application on the part of the men. It also necessitates a closer supervision of both men and machines and a general "tightening up" of the industrial mechanism all round.

Because of this, and from a general apprehension that the new order of things may in some way work to their disadvantage, the men will almost inevitably oppose the installation of an efficient cost system. In this the foreman is apt to side with the men. He may really wish to advance the interests of the management, but his heart is with the men and especially so where he has served his time in subordinate capacities in the particular department over which he now holds sway.

The foreman's attitude to the cost system is of very great importance as it is practically impossible to install a successful cost system in the face of his active opposition. Tact, good feeling, and the utmost openness will usually prevent or overcome opposition from this source.

If the whole matter is presented to the foreman properly—and through him to the men—the support of both should be secured. If it cannot, the condition is one which must be treated individually. In several cases which have come under the author's personal observation, the dismissal of foremen, otherwise seemingly good, who opposed the installation of a cost system has had a very salutary effect. A foreman is not really good if he persistently works at cross purposes with the management.

§ 17. Attitude of Labor to Cost Accounting.

The successful installation of a cost system depends largely upon the proper frame of mind of the workmen. On the surface it might appear that the employees in a factory have nothing to do but follow instructions. This is true, but they will, if the spirit of insubordination is abroad, follow instructions with such density of apprehension as to make the general plan of costing—no matter how well it may have been devised—burdensome, ineffective, and costly. On the other hand, if the workmen can be shown that the new cost system is not inimical to them—if they can be induced to give

it their cheerful support, to make their reports promptly and correctly, and to accept suggestions for economy of time and material without ill-feeling—it makes strongly for the success of the plan and goes far to increase its ultimate effectiveness and value.

The cost system if properly used gives a close and intelligent comparison of individual effort, and leads to the proper classification of employees. This is obviously to the advantage of the employees and should be appreciated by them. These comparative records, however, act in themselves to stimulate the men and eliminate much unnecessary wastage of time, and this more immediately apparent feature does not appeal to the average employee. On the contrary, it is a strong argument in the minds of many workmen against all cost systems.

This opposition should, however, be easily removed if the men have confidence in the management. Greater productive efficiency of labor should be advantageous to both employer and employee, for "increase in efficiency makes the payment of high wages possible, and it may be added that without efficient labor, high wages cannot be paid indefinitely, *for every wasteful operation, every mistake, every useless move has to be paid for by somebody, and in the long run the workman has to bear his share.* * * * The best mechanical equipment of a plant that money can buy avails but little if labor is not properly utilized. On the other hand, the efficient utilization of labor will often overcome the handicap of a very poor equipment."*

§ 18. Efficiency Requirements.

A high degree of labor efficiency cannot be secured unless there is fair dealing and proper feeling between management and men. Their rights must be respected, their status must be reasonably sure, and their personality must receive

* Gantt, "Work, Wages and Profits," pp. 41, 42.

proper consideration. Each man has his own peculiarities, and any system of management or discipline too inflexible to allow some latitude for variations from the normal, does not measure up to modern requirements and will not secure the best results.

The conditions under which labor is performed must also receive careful attention. If the arrangement of the shop is convenient, if tools are at hand when needed, if work in process is routed so as to avoid all unnecessary handling and hauling, if the conditions of physical comfort are properly cared for,—all these militate directly and materially to increase efficiency and decrease costs.

The manufacturer, if he would be really successful, must recognize the fact "that every machine he has in his factory, every part of his product, every sale he makes, every dollar of his investment depends for its efficiency on a man. Merely contented men give a better result than mere men. Enthusiastic men give a better result than contented men. Men with pride in their work, with enthusiasm in their blood and loyalty in their hearts can whip the world. * * * When you get down to the men, show them that you trust them, tell them what you expect them to do and that the system of costs is simply to protect them and you and your stockholders."*

§ 19. Workmen's Tricks.

Labor costs will vary widely on occasion from legitimate causes. Thus it sometimes happens that one man can prepare a tool or machine in less than half the time that another man takes for the same work, and this difference in time of preparation accounts for a wide difference in the time per unit required for the operation as a whole.

Beyond these legitimate variations there are many variations due to the frailties or peculiarities of employees. Every manufacturer knows the shortcomings of certain classes in

* E. St. Elmo Lewis.

the great army of labor and the disastrous effects of these shortcomings on costs. The rapid but not careful man who makes mistakes which may or may not be discovered; the poor workman who wastes both time and material; the man who holds back his output; the clock-watcher who refrains from taking up the next job for fear that at some time in the near future the whistle may blow; the "putterer" who fusses with his machine much longer than is necessary,—all these are familiar figures in the workshop and are fruitful causes of varying labor costs.

It is a fact that workmen, speaking broadly, are honest. It is also a fact that many cost variations are due to acts on the part of the men which are distinctly dishonest. In some shops, for instance, the "setting up" process is done on a time basis and the work thereafter on a piece-work basis. Under such circumstances a tendency is sometimes found to extend the time record as long as possible so that piece-work may begin while the time is still going on—a petty trick which can only be prevented by a close supervision.

The same deferred time-recording trick is sometimes attempted where the premium system is in vogue. Thus when a workman has finished a time job in less than the usual time allowance, but has not gained enough time to earn a premium, he will start a new job and avoid ringing or recording "off" on the finished job until the usual time allowance has been fully consumed.

In the case of premium work the surest preventive of such deceptions is a penalty to be levied against the offender's premium. When not on premium work, and when it may be done without too much loss of time, impositions of this nature may be prevented by having all job tickets retained by the foreman or his clerk until the preceding job has been completed; or each workman may have two or three jobs and no information be given as to the job which is to be taken up next until the job in hand has been completed.

Where the matter is controlled by withholding tickets, a good arrangement is to have a job ticket rack equipped with an electrical contrivance whereby each workman's ticket is held, face inward, on a separate hook or ring, each hook or ring when opened to remove a job ticket breaking or making a circuit, as the case may be, and thereby electrically recording the hook or ring number and the time the ticket was lifted.

§ 20. Dead Time.

While corporations are usually characterized as "soulless," yet oftentimes employees are kept on the pay roll when their absence would be more helpful to the payment of dividends. They are in effect, though not so regarded, pensioners and their position may be anywhere from the top down. Wherever they are, the cost of their maintenance is undoubtedly there also, and the loss is disclosed by the operations of an effective cost system.

Good feeling and good business may prompt the retention of such employees, but, as from the cost viewpoint they are directly unprofitable and are retained largely for other reasons than their output, they should not be classed or compared with effective labor. They are a part of the general cost of conducting the business, but are not entirely a part of production cost. As a general charge on the business the amount paid in excess of their labor values may be immaterial, but charged into specific costs it is sometimes distinctly misleading.

§ 21. Wages.

The question of wages is always a live one—and one with a very direct bearing on costs. Overpaid labor means heavy costs. Underpaid labor too frequently means poor workmanship, strikes, and ultimate loss. With the growth of intelligence among the laboring population and the ability

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to enforce their demands, together with a growing recognition on the part of employers that a fair wage must be paid and perhaps a growing willingness to pay this fair wage, the question of labor compensation is one for fair adjustment.

The consideration of a just wage is one which, as stated by the late Carroll D. Wright,* "reaches beyond the hackneyed statements of the old school that the interests of labor and capital are one, and incorporates them with another that they are reciprocal."

While the necessity for fair wages is quite generally recognized, the matter is but seldom given the intelligent consideration it deserves. What constitutes a fair wage? Shall it be determined by a naturally quick and carefully trained "pace-setter" or shall it be fixed on the basis of a normal average performance? There is a growing recognition of the fact that any efforts in excess of average performance must be paid in excess of average wages.

"Men, as a whole (not mechanics only), prefer to sell their time rather than their labor, and to perform in that time the amount of labor they consider proper for the pay received. In other words, they prefer to work by the day and be themselves the judges of the amount of work they shall do in that day, thus fixing absolutely the price of labor without regard to the wishes of the employer who pays the bill. While men prefer as a rule to sell their time, and themselves determine the amount of work they will do in that time, a very large number of them are willing to do any reasonable amount of work the employer may specify in that time, provided only they are shown how it can be done, and paid substantial additional amounts of money for doing it. The additional amount needed to make men do as much work as they can depends upon how hard or disagreeable the work is and varies from 20 to 100 per cent. of their day rate.

"If the work is light and the workman is not physically

* "Phases of the Labor Question," pp. 40, 41.

tired at the end of the day he will follow instructions and do all the work called for if he can earn from 20 to 30 per cent. in addition to his usual day's wages. If the work is severe and he is physically tired at the end of the day he requires from 40 to 60 per cent. additional to make him do his work. If in addition to being physically tired he has been obliged to work under disagreeable conditions or in intense heat, he may require 70 per cent. or even 100 per cent. additional. These facts are derived from experience and give us a key to the intelligent purchase of labor."*

§ 22. Piece-Work and Costs.

Among the many plans for a more satisfactory adjustment or settlement of the wage question, is that of piece-work. The impression prevails among those in charge of manufacturing operations that where labor is on a piece-work basis or on what is known as the contract system, labor costs are thereby fixed. This impression is at least approximately true when piece-work is done outside of the factory. Inside the factory it is not necessarily true. Frequently it is quite the reverse of true.

When two piece-workers, sitting side by side, are getting the same labor price per unit, it does appear at first sight that the cost price of their product is the same regardless of the comparative speed of the two workers. This is, however, a mistake. The material used and the labor cost is or should be the same in either case, but the burden of overhead expense—the third element of production cost—is not the same, varying in every case with the time consumed. Overhead expense is running relentlessly, and if one piece-worker halves the time of his slower companion, the burden of expense on his product is, roughly, but half that which must be carried by the product of his companion. Unless this fact is clearly recognized and taken into account, accurate records and the

* Gantt, "Work, Wages and Profits," pp. 38-40.

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lowest practicable production costs are impossible. To attain these lowest production costs, the maximum capacity of the factory must be utilized, and this maximum capacity cannot be reached until every employee of the factory is making the very best possible use of the facilities at hand; i. e., is working at the highest economic productive rate.

The direct relation between overhead expense and production time is a strong argument for piece-work, as nothing reduces production time so materially as a fair and fairly applied system of payment on the basis of production. The system, whatever it may be, must, however, be justly operated. Too often when the piece-worker reaches a high output and a resulting high wage, piece-prices are cut to curtail his apparently excessive earnings. The result is disheartening to the employees and is apt to be disastrous to the employer. Rapid operators are afraid to work up to their capacity, slower workers cannot make a fair wage, production is spasmodic, the general results are unsatisfactory, and the whole system comes in for unmerited odium and distrust.

The practice of cutting wages to prevent large earnings under the piece-work system is vicious from every standpoint. Speaking generally, no matter what the rapidity of the individual workman nor the amount of compensation he receives, the cost of his product is not increased from the wage standpoint, but, on the other hand, from the standpoint of overhead expense is materially decreased. Under these circumstances, if the manufacturer cuts the rate on his rapid workers he penalizes them for decreasing costs, loses their confidence, and demoralizes his whole force.

§ 23. Men vs. Machinery.

A question of importance not infrequently arising when costs are scrutinized closely is the relative economy of men and machinery. Is a special operation performed more eco-

nomically by man power or by machine power? The matter is not always easy of determination.

For instance, a section of steel for a huge axle requires what blacksmiths term a "boss," which, properly machined, becomes the collar of the axle. This boss may be put on by special machinery, but is frequently put on by "might of man." In this latter case, when the steel is ready for its boss, from twenty-five to thirty men are called away from their regular productive duties in various parts of the plant to man an enormous battering ram, and by repeated heavy blows of this ram upon the end of the steel bar, produce the boss.

Such an operation may be necessary once a week perhaps and, if so, its expense is considerable. Its greatest cost is not found in the wages of the men for the ten minutes or so in which they are actively engaged at the battering ram, but in the loss of time and general disturbance involved in calling these men from their regular vocations for the special work.

The amount of this loss will be better appreciated when the conditions are more fully understood. In the case instanced, when the piece of steel is put into the forge for heating, a messenger is sent to the various workmen whose services are required for the "boss," to the end that they may plan so that they may leave without serious injury to their own work when the axle is ready. As soon as the men are notified of the approaching special duty, the individual efficiency of each drops to a low point. Each individual is looking forward to and arranging for the special duty. His mind is not entirely on his own work, nor can he conduct his work to the best advantage. If he be himself a smith he is not free to put more irons in the fire as he cannot properly care for them.

As soon as the steel has attained its proper heat, the men are called and their own work is dropped for the special duty before them. This is perhaps done with "neatness and

dispatch," but as soon as the men are through there is usually more or less friendly hilarity and good fellowship among them, there is no haste to resume their individual tasks, and it may be an hour or more before the routine work is again fully and efficiently under headway.

To determine the actual cost of such interruptions, the time actually spent on the special duty must be taken into account, and the cost of the orders in work at the time of the interruption must be closely scrutinized and compared as to labor costs with the same costs under normal conditions.

The proper cost system can usually be relied upon to reflect such variations of labor cost with reasonable accuracy, and the management can then act with a full knowledge of the facts. The direct and indirect costs of the operation when performed by "man power" are known. The cost of proper machinery and the cost of the operation when performed by this machinery may be readily ascertained. It is then, as a rule, a simple matter to determine which is the more economical.

There is, however, at times so nice an adjustment between the relative merits of men and machinery as to make such a determination difficult. Even a small saving per unit on a large output is well worth while, but the saving effected by the new mechanism may be so infinitesimal that its real value is very difficult to determine and the management naturally do not wish to install more or less expensive machinery unless there is a clearly demonstrated advantage in so doing.

To demonstrate a point of this kind is a matter of scientific cost finding and time. No machine should be condemned on an out-of-date or inadequate system of cost finding, nor should its fate be decided by a short trial unless the short trial shows beyond question that the machine is not worth while.

It must also be borne in mind in considering the utility of any new machine that its economy may depend largely on

the frequency of its use. A device obviously and materially labor saving, if used but a few times a year would not in most cases be a profitable installation.

§ 24. Men vs. Machinery. Differing Views.

The different points of view when the relative merits of men and machinery are under consideration, are well brought out in the following account of an American manufacturer's investigations into this subject in Vienna. He was amazed at the wasteful methods and the high labor cost that resulted from the failure of the Austrian manufacturers to use modern machinery.

" 'I was informed in one shop that a boiler of about 150 horse-power cost for labor alone $750. That boiler would have been built in an up-to-date shop in America for a labor-cost of $150. In the United States three workmen with modern tools would accomplish as much in one day as would be done by four workmen in a Vienna shop working one week. The cost of the labor in the United States would be about $5, the men receiving for this class of rough work a little more than $1.50 a day. Of the four men in the Vienna shop, two would receive eighty cents a day, one sixty cents a day, and one forty cents, but even at those low wages the total labor cost there would be $15.60 against about $5 with us. I found an almost absence of labor-saving machinery in some of the largest shops in Vienna—plates were being handled by hand; there were no riveting machines, no travelling cranes, or modern hoists.'

"I asked a large manufacturer in Vienna why he did not introduce modern labor-saving machinery. He had been in American shops and was fairly well posted on what was possible in the way of reducing the amount of labor entering into his product. His line of reasoning was interesting:

" 'You will not find the latest labor-saving machinery here,' he said, 'because labor is so cheap that it does not pay

to have the best machinery as it does with you. If we invest money in labor-saving machinery, the interest on the cost of that investment goes on every day in the year and every succeeding year, whether times are good or bad and orders many or few. With our cheap labor it is different. When we have a rush of work we can employ more men; in slack seasons we can discharge them. The trouble with labor-saving machinery is that you cannot discharge it when you have no work for it to do!' "*

* Vanderlip, "Business and Education," pp. 154, 155.

CHAPTER III.

DETERMINATION OF PRODUCTION COST.

§ 25. Constituent Elements of Production Cost.

Material, labor, and expense are the three constituent elements of production cost. All of these are equally important, for no two can be combined without the aid of the third. In other words, there can be no commercial production without bringing into combination the three elements,—material, labor, and manufacturing expense. For instance, if a simple type of machine is to be constructed, material, such as castings, etc., is a first requisite. A machinist, representing the labor element, must then be called upon to prepare and assemble the various parts. A place in which, and tools with which to do this are further essentials, and these two latter items supply the third element of production cost—manufacturing expense.

Primarily there is no necessary relation between these different elements of cost. A very large amount of labor may be expended upon material of insignificant value, as is the case in the manufacture of many instruments of precision where the material may cost but a few cents while the labor and manufacturing expense involved amount to many dollars. On the other hand, the material may be very costly while the labor and the manufacturing expense involved are of small comparative cost, as in the manufacture of plain gold rings.

As a rule, production costs are decreased as the volume of production increases. The cost of material is decreased because the material is purchased in large quantities and

therefore on better terms. The labor cost is usually decreased because the larger number of laborers permits of specialization by classes and groups, makes effective "team-work" possible, and precludes the necessity of "filling in" the time of high-priced men on work which could be done equally well by men of lesser wage-earning power.

When we come to manufacturing expenses we frequently find that many of them are not increased at all by an increase of production,—due to the fact that the limit of productive capacity has not been reached. Thus, if but one man is employed in a good-sized shop, the fixed charges on the land, building, and equipment, together with the cost of heat, light, power, and insurance, will amount to a very considerable burden on his product. If, however, ten men are employed in the same shop, many of these items are not increased at all and possibly would not be materially greater if the working force were increased to one hundred men. Where this is so, the burden of expense on each unit of the increased product is but a small fraction of what it was before.

§ 26. The Cost Period.

In former years the determination of costs usually waited until the end of the fiscal year, when an inventory was taken and the costs roughly determined. Modern requirements demand closer, more accurate information. If production costs vary, the management must know, and know quickly what the variation is, the cause, and, if an increase, whether it may be rectified or whether it necessitates a corresponding increase of selling price.

For this reason, in the great majority of producing establishments, the old annual period is displaced by a shorter period—usually a monthly or four-weeks' period. The four-weeks' period, making thirteen periods in the year, is advisable where the pay roll is weekly or bi-weekly, and the calendar month period is advisable where the pay roll is monthly

or semi-monthly. The plan of having the closing period "articulate" with the pay-roll period enables the cost department to get at the facts of labor costs without having to "dig" for them.

§ 27. The Perpetual Inventory.

In the more modern manufacturing establishments a perpetual or "going" inventory takes the place of the annual physical inventory of former days. This perpetual inventory may be said to be essential to an accurate and effective cost-accounting system. With it, the goods on hand, and their values, can be determined from the books at any time with but little labor and delay. This permits of the short cost periods which would not be possible under the annual physical inventory.

The "perpetual inventory," "going inventory," or "stock record," as it is variously called, is a continuing record of materials, goods in process, and manufactured goods on hand. It shows both numbers or quantity and value. If materials or goods are used or sold, they are deducted from the quantities or numbers shown to be on hand by the perpetual inventory, so that this inventory shows at all times just what materials and goods are on hand and their value.

The going inventory is nothing new. "A cash book is a stock record, or going inventory of cash, because it shows all cash received, all cash disbursed, and the cash on hand and in the bank. Likewise a customers' ledger is a perpetual inventory of debts due the business by its customers. * * *

"There are certain lines of business in which the keeping of a stock record would be impractical if not impossible; e. g., retail grocery business, retail liquor business, retail hardware business, wholesale novelty business, etc. Where this is the case, an accurate statement of assets and liabilities can not be compiled from the books except after a physical inventory is made. Consequently the management must wait

six months or a year in order to know the exact condition of the business and the results from its operations.

"As opposed to this, where a stock record is feasible and is correctly kept, the management can ascertain at the close of each week or month, as they may elect, the condition of the assets and liabilities, and the results from the operations of the business. In practice it is usually not advisable to compile a balance sheet and a profit and loss statement more often than monthly."* (See also §§ 46-48.)

§ 28. Advantages of the Perpetual Inventory.

The perpetual or going inventory is, as already stated, an essential feature of accurate cost finding. It may be said further that it is a prime requisite of any modern system of accounting. It affords, in itself, a good illustration of controlling and subsidiary records. In the Main Ledger or the General Exhibit (Ch. XXXIV) it is represented by a few controlling accounts, which show at the end of each month the aggregate cost of stock and materials on hand. In the subsidiary records the supporting accounts give a complete analytical statement of the property values represented by the controlling accounts, showing under each heading the quantity or number on hand, and the cost price per unit.

The advantage of such a record is great. When it is kept the exact status of all asset accounts and the exact condition of all material on hand can be ascertained without leaving the office. This permits of the short cost period so essential to accurate cost finding. It also gives a knowledge and close touch of the business that can be secured in no other way. In short, the perpetual inventory, when part of an effective modern system of accounting, enables the factory to be run from the office—a wonderful advantage under any circumstances and particularly so when a business is under stress of competition.

* Bentley, "Science of Accounts," pp. 115-117.

As illustrating the great practical value of the perpetual inventory—outside of its costing utility—a recent experience of two very large corporations manufacturing a common line of product may be cited. Each of these in turn was asked by a large consumer of their common product to state the earliest date when delivery could be made on a large rush order. The first concern, lacking a modern system of records, at once got into telephonic communication with a number of its different plants, had its whole corps of superintendents on edge looking up data and reporting conditions, and gave a positive reply in some two days from the time the enquiry was made. The second concern, equipped with a modern accounting system, consulted the records on file in its office, ascertained the conditions in each of its plants, gave a decisive reply within half an hour from the time the enquiry was made, and secured the order before its competitor had worked out a delivery date. (See also §§ 46-48.)

§ 29. Cost Determination.

All production cost is made up of the cost of the three elements—material, labor, and manufacturing expense. Each job passing through the factory, or each lot passing through a process, is given a distinguishing number, known as its "order number." To this order number is charged the material directly consumed. All labor devoted to that job or lot is charged to its order number. To each order number is charged its proper proportion of manufacturing expense.

While thus simple in theory, the practical determination of costs is one of the most complex and difficult of the tasks ordinarily required of accounting. Separating the routine of cost finding into its parts, it is easily seen where the complexity lies.

Material costs are usually simple, requiring only the charge for material actually consumed.

Labor costs, while still comparatively simple, are more

difficult of determination than material costs, owing to the fact that labor does not go into a specific job in the clean-cut way in which material usually does. Thus, a single job or lot may pass through many different processes and departments and through many different hands. It may be worked on steadily until completed, or be worked on at many different times. It may be taken up alone or in connection with other jobs, or to fill in time between other jobs. All this makes for complexity. However, under any of these circumstances the matter is for the most part merely one of accurate time keeping and therefore of not very great difficulty.

Expense is the "bugbear" of the cost finder. It is the great cause of the difficulties, the inaccuracies, and most of the divergencies in both the theory and practice of cost finding. Expense is a material part of manufacturing costs—sometimes by far the greatest part—but it is to a greater or less extent, an elusive, intangible part, showing in results but not fully seen, always present but difficult to trace, multifarious in its origin but united in one burden on production costs, and ever and always exhibiting an almost unconquerable tendency to swell these costs unduly.

In practice, expense is the uncertain element of cost accounting. At the best the expense charge is but an approximation. Its determination and proper diffusion is the most difficult feature of the cost accountant's work.

The application of material costs is treated in Ch. VII of the present volume, the application of labor costs in Ch. X, and the application of expense in Ch. XVIII.

CHAPTER IV.

ROUTINE OF PRODUCTION.

§ 30. The Production Order.

In its usual form the production order is a formal written direction or authorization for product to be put in process, or, applied to non-productive work, it is the direct or standing order for such work to be done. As a broad rule, no factory work, whether productive or otherwise, should be begun unless covered by a specific order. In the case of frequently recurring duties of a non-productive nature, such as cleaning out tanks, oiling machinery, small repairs, etc., standing orders are usually issued, and all work done under such standing orders is charged to the particular order number to which it belongs.

The first step in the manufacture of an article or product under a modern cost-accounting system, is, then, the issuance of a production or assembling order, as the case may be, which is a general authorization to those concerned to proceed with the manufacture indicated. This they do in accordance with the formalities and routine of the particular factory. Where parts are necessary these are usually provided for by means of shop orders which bear the same number as the "controlling" production order.

There is no generally observed rule as to the official by whom the production order is issued. Nor is there any general uniformity of practice. Every factory is a law unto itself, and its production order numbers are issued by such official or officials, or in such manner as seems best to its management.

§ 31. Forms of the Production Order.

As already stated, there is no uniformity as to the formalities attending the issuance of a production order. Similarly, there is no standard form, every factory adopting such shape and arrangement of production order as fits in best with its own requirements. Indeed, as a matter of practice some lines of production issue no formal written orders at all, and there are circumstances under which written orders would be of no particular advantage. Thus, where the production is standard and continuous, the product may be turned out day after day under a standing order or with no production order at all. At other times production is begun on a verbal order from some one in authority, with perhaps a scale ticket or sheet showing each lot number with weights or inspection tallies, or other analogous record to serve as an identification. This class of production is illustrated by packing houses with their "bunches" of live stock, and saw mills with their "jags" of logs.

While this is true, the general rule holds good that production should always be authorized by a more or less formal written production or assembling order, or by shop orders for parts that are to be carried in stock, each such order bearing a controlling production order number. Different forms of the production order are described in the paragraphs which follow.

In its simplest form the production order is merely a direct request, order, or authorization to the proper party to begin a specified production. In its usual form the production order goes beyond this, giving various details as to the product, frequently combined with a requisition for material. To this are frequently added blanks for information concerning the progress and the details of production so that when the operation is finished the production order itself shows a more or less complete record of the whole operation.

Thus in the manufacture of shoes specific orders are put

into process with a "tag" to accompany each "case." This tag is in itself the production order but also bears the relevant data concerning production details, and follows the goods from start to finish, serving in this way as a job follower. In the more modern shoe factories, what is known as the "sheet" system or "schedule" plan is used to put the lots, under the different tags in work in carefully arranged daily groups, moving through the factory on a prearranged schedule so that there will be no localized congestion nor interference between the various specific orders, while at the same time the full capacity of the plant is utilized.

The schedule plan is not peculiar to shoes but can be used with any product of a fixed process nature. Furniture, soap, iron safes, etc., are examples of such product, and in fact any other product that meets the requirement of the list-percentage plan (see Ch. XXI) can be worked under the schedule plan. The prearrangement of work involved, with the subsequent pressure on all sides to keep production up to the schedule time, is very advantageous. This feature of the plan can to some extent be used on specific orders other than "process" product, as will be seen by reference to the shop order tag (see § 33) shown in Figure 22, which fixes the date on which the article must leave each department.

In Figure 10 is shown a tag plan of stores order used for semi-finished material, or for finished parts of standard machine product that is made up and held in stock for probable future needs. This tag tells all that is necessary to be known in regard to the ordinary parts for which it is intended. If anything out of the ordinary is desired, another form of shop order or production order is issued giving the details of this special production.

In Figures 11 and 12 is shown a form for recording production—including receipt for product—on an indeterminate or "until I tell you to stop" plan. This is for parts of a standard agricultural implement. The use of the form as shown

is limited to one week. This is primarily for the purpose of checking up production with the corresponding time reports.

Figure 13 is an order sheet for a manufacturing tailor, used when garments are given out to journeymen to be completed in their own shops and homes. The lower portion of each garment ticket is detached before the garment is returned to the main shop, the coupon being retained by the operator as a pay coupon indicating the amount of work done by him for which payment will be due on the regular pay day.

In Figure 14 is shown a small card that accompanies each dozen cut garments in an underwear mill. This constitutes the production order and is all that is necessary in process work of this kind where the operatives perform their special duties on all garments that come to them in the course of routine. The first operation is listed at the bottom of the card, the second operation next above it, and so on. As will be noticed, a space is left for the operative's check number to the right of the symbol representing the operation. After this check number is inserted, the operative cuts off the coupon to the right and retains it as a pay coupon—i. e., a voucher showing work which has been done for which he is entitled to compensation. The operatives paste these coupons in books prepared for the purpose, which they turn into the office for pay-roll purposes. To avoid fraud these cards or tags when first issued are stamped the length of the tag with a rubber stamp of peculiar design. The production order for the original cutting of garments cannot, of course, be worked on this plan.

In Figure 15 is shown a form of wood-shop order for constituent parts of agricultural implements, baggage trucks, cars, etc. This form is peculiar because in order to use lumber to the best advantage, several shop orders may be executed simultaneously, and in fact a cross-cut sawyer may have half a dozen orders in hand and use his judgment in cutting to advantage. Under this plan any lumber taken from the

piles is charged to the department material account, and the extensions are made in the office at a rate per thousand feet which includes the exact measurements for the finished parts and a margin for waste as determined by experiment or by the experience of preceding cost periods.

In Figure 16 a producing order for liquid paint is shown. The squares represent the various sizes of containers, and the numbers written in the squares show how many of each of these containers are to be filled, thus serving as a guide to the quantity in bulk to be produced. This form carries with it requisition blanks for all material which should be necessary. In Form 17 is shown the completing order for one size of container of the same paint. This carries with it the requisition blanks for containers and labels.

Figure 18 shows a production order and material requisition for parts of a steel wheel. The form shows the method of recording "rejects" and the number of good parts passed on to the succeeding operation.

Figure 19 shows a production order and material requisition for machine knives. This form is arranged to record the scrap made on each order and thus becomes an individual efficiency record for the operative.

In Figure 20 is shown all that is ordinarily needed in the way of a production order for the various departments of a safe works when the cost system is on the process or list-percentage plan. The form as shown, covers the making of hinges for stock. It will be noticed that space is left for recording any requisition that may possibly be made—as a matter of expediency—on the newly made stock before it has been formally delivered to the stores department.

Figure 21 shows a job follower for a printing plant. This order is in the form of an envelope designed to contain copy and any and all relevant data necessary to the work.

Figure 23 shows a combined order form and machine time report for use with the machine hour plan; each coupon representing a separate operation.

§ 32. Routine in Production Department.

In the following discussion of production routine it has been assumed that the premium system is in use. Where this is not the case the reference to premium time, etc., on forms, and the records peculiar to the premium system are, of course, omitted; otherwise the routine is the same.

The procedure described in the following paragraphs is that followed in the production of parts in a machine shop. The general plan is, however, by no means limited to machine shops, but applies to many classes of production. It would, of course, vary in detail in different shops and for different classes of product, but will serve to give a general idea of the accounting routine involved in production.

In most machine shops in which an effective cost-finding system is in operation, a record of all parts which are made in the factory is kept in the production department on a card index. This gives the following information in regard to each:

(1) Name of part and size.
(2) Material.
(3) Pattern number.
(4) Drawing number.
(5) Time required to manufacture.
(6) Number made in lots.
(7) Minimum stock to be carried.
(8) Operations.
(9) Departments in which operations are to be carried on.
(10) Premium time allowance.

On the back of this card is shown the number of parts then in process in the factory, the number of parts in the stock room, and any withdrawals of these parts. This gives a perpetual inventory of stock on hand. When the production clerk receives an assembling order or a production order involving the use of these parts, he examines his card index to see what parts he has in stock and what parts must be made. He makes a record of the parts to be made and

turns this list over to a clerk who fills out shop order tags—which are in effect subsidiary production orders—and cost cards (Figure 126), and forwards them to the stores clerks and cost-keepers respectively.

§ 33. The Shop Order Tag.

The manila tag shown in Figure 22 is a convenient form of shop order. It gives the following information:

(1) Shop order number.
(2) Amount to be made.
(3) Articles and size.
(4) When material is wanted.
(5) When article is to be finished.
(6) Operations.
(7) Departments in which operations are to be carried on.
(8) Premium time allowed on each operation.
(9) Date when work must leave each department.

The bottom of this tag may be a material stores coupon or requisition, the tag being so perforated that the coupon can be readily detached. To avoid error or misunderstanding, a small blue print of the parts to be made accompanies the tag, or better still is attached to it by a fastener. On the face of the stores coupon should appear the shop order number, the name of article, material wanted, amount, size, date delivered, and "Return to Material Clerk." On the reverse side should appear the date received, amount, balance in stock, and "Counted by ———."

The blue print idea can be used to great advantage in other than machine shops, as for example in a pharmaceutical laboratory where each separate formula can be typewritten upon a specially ruled and prepared sheet of translucent paper and thereupon becomes the master copy for all future production orders based on that formula. These master copies are filed by number or other designation so that they may be readily found when needed. When production orders are to be put in work, a blue print is taken from the prepared

sheet bearing the proper formula, which—if the master copy has been properly prepared—becomes the production order form with blank white spaces for order number, date, quantity, etc.; also for recording the names of employees who perform the several successive duties incident to the fulfillment of the order. This plan is a safeguard against inaccuracies and precludes the necessity of numerous checkings and rechekings.

§ 34. Routine of Shop Order.

When the shop order tag reaches the stores clerk, he notes the date on which any castings required will be needed and orders this material from the foundry, setting a delivery date upon the order. When the castings are received from the foundry, he stamps the date under heading "Material Received." The tag is then held by the particular stores clerk who handles castings, until, as time rolls on, the date indicated under "Date Wanted' is reached, when it is sent with the castings to the main store-room.

On receipt of the tag the storekeeper counts out the pieces called for by the order, and, first detaching the stores coupon, attaches the shop order tag to the material and sends tag and material to the department in which the operation begins. The storekeeper then signs the stores coupon, first entering date, weight, and cost of material on the back of this coupon and forwards same to the cost-keeper, who enters the cost under "Material" on his cost card and files the coupon away for reference if the necessity arises.

The tag attached to the material saves the foreman's time and greatly simplifies his work. He does not have to start an investigation to obtain the necessary information in regard to a job, nor does he have to even consult the blue print to see to whom the work goes after his part has been done, for the tag is like a railroad schedule, stating each point of destination and the time of arrival thereat.

When material for a job arrives in a department, the foreman reads the attached shop order tag, notes the date when the work has to leave his department, and turns the job over to the workman who does that class of work. This workman while still engaged on other work, gives the tag with its attached blue print to a tool carrier, who gets such tools as are needed from the tool-room and deposits them on the workman's bench. When the workman finishes the job he is on, tools and materials are at hand for the next job and no time is lost.

When the work is finished—usually either before the schedule time or exactly on it—it goes to the inspector. If approved, it is immediately forwarded to the next department, and so on through the different departments to the stock-room. When the finished work reaches the stock-room, the parts are counted, placed in their proper receptacle, the form on the back of shop order tag is filled out, and the tag is then sent to the production department. Entries are made from this shop order to a card properly ruled to record the operations, symbols, and departments in which the work was done, and the time consumed.

§ 35. Time and Premium Records.

The time record card (Figure 126) for each operation is made out at the same time as the shop order tag, and is forwarded to the cost-keepers who file it away according to its guide number. As time reports come in from the factory for the particular work, the time is posted on this card, and the number of men employed on the work is also inserted. The card is kept on file in this department until the finished shop order tag returns from the stock-room to the production department, when the time record card is taken from the files and the premium figured.

§ 36. Discrepancies and Losses.

When the cost of any part has been figured on the cost

card, the unit cost is transferred to comparative cost sheets, where a record has been kept of all preceding costs and where any discrepancies will be discovered. Should an increase in cost over the previous lot be shown, a comparison of the two cost cards will show where the discrepancy occurred, and the cost department can notify the superintendent of the date, the operation, and the workman who was responsible for the increase of cost.

Notice of work rejected is made out in duplicate by the inspector. The original of this notice is sent to the foreman of the department. The duplicate is sent through the superintendent to the cost department, where if the rejection is due to a fault of the workman, the time lost is charged against his premium gain on that particular job, but otherwise goes to swell the burden of overhead expense.

PART II.—MATERIAL.

CHAPTER V.

PURCHASING AND RECEIVING MATERIAL.

§ 37. Requests for Purchases.

Requests or requisitions for the purchase of material (Figures 40, 41) usually emanate from the stores department. They are made out by the stores clerk or some equivalent official and are sent to the material division of the cost department for registration. Here by reference to the stock record, the propriety of the proposed requisition is determined. If the purchase is approved, the order is entered in the "Material Ordered Register" and the request for purchases is turned over to the purchase department where a purchase order (§ 38) is made out in accordance with the request and the order is placed.

The completeness of the information conveyed in the request for purchases will depend entirely upon the system in force in the particular establishment. Under some systems detailed information is incorporated in the request, as for instance, the number of units on hand, number needed for immediate consumption, number already ordered but not yet received, etc. On the other hand, requests for purchases are sometimes mere statements—each under a number which becomes the number of the corresponding entry in the Material Ordered Register—of the fact that certain goods are needed. The purchase request must, of course, be signed by the proper party. In some large concerns two or more signatures are required for the validation of purchase requests.

§ 38. Purchase Orders.

The purchase order under any modern system of business organization is a printed form upon which the details of the specific order are entered. When these have been entered the purchase order is sent to the supply house or concern from which the goods are bought and becomes its authority for the delivery of the goods ordered, in conformity with the terms of the purchase order.

There is no fixed wording, style, or form for purchase orders, the matter being entirely within the discretion of the individual concern. They should, however, as a matter of course, be as clear, direct, and specific as they can be made.

Whatever the general wording and arrangement adopted, the purchase order should always bear a serial number and a request that this serial number appear on the seller's invoice. This is a matter of some importance, for in case any question arises as to the authority for an order, or as to the quantities or qualities or other conditions of a bill of goods, it is a simple matter to turn to the duplicate of the purchase order—which is filed under its serial number—and determine the facts.

The purchase order is usually composed of a set of four duplicates, though occasionally purchase systems call for sets of a smaller or even larger number. While commonly referred to as duplicates, the different copies of the purchase order set are not, strictly speaking, duplicates, for while the specific order details—which are typewritten in—are the same on every copy of the set, the printed matter usually varies on the different copies. The variation in the printed matter is shown in Figures 42-45 which illustrate the four members of a purchase order set.

The different copies constituting a purchase order set are prepared at one operation by the use of carbons. When four copies are prepared, the different copies are utilized as follows:

(1) Sent to supply house.
(2) Filed in numerical order in the office.
(3) Placed temporarily on "Unfilled Orders" file.
(4) Sent to receiving department.

When orders are important and to be closely safeguarded, the blanks constituting the set of four copies are printed on a single sheet of paper, part on one side of the sheet and part on the other, each separated from its fellows by perforations. Copies 1 and 2 appear on the face of the sheet and copies 2 and 4 on the reverse of the sheet, in such manner that an "accordion" fold of the sheet will bring the consecutive copies in sequence, all facing the same way and registering so that when carbon paper is placed between, all four copies may be prepared with the one writing.

These purchase order sheets are machine-numbered and padded. If a sheet is spoiled it is destroyed—save as to copy 2—by the proper officer or department head. The destruction of the other copies is tersely recorded upon copy 2, which is then filed in its proper numerical order with the other No. 2 purchase orders so that every sheet is accounted for. This plan precludes the possibility of promiscuous or unauthorized orders.

For convenience in handling, it is desirable that the different copies of a purchase order shall be readily distinguishable one from the other. For this purpose when all copies are printed on a single sheet, different styles of type or different colored inks may be used. When the copies of the set are not printed on one sheet they may be distinguished in the same way but are best differentiated by the use of a different colored paper for each copy. Sometimes they are distinguished by the quality or weights of paper used. Another excellent plan of distinguishing the different copies is to have a large designating figure printed on the corner of each copy save the first.

The printed wording of the purchase order usually varies, as stated, on the different copies. Thus No. 1, the original,

is in its usual form a direct order for goods. In addition it sometimes carries an acknowledgment "extension" on the left-hand side, separated from the purchase order proper by perforations. This acknowledgment is to be signed and returned by the party receiving the purchase order, and if properly worded it becomes, when so returned, not only an acknowledgment of the order but its positive acceptance at the price and on the terms stated in the purchase order. If this acknowledgment is not promptly received, a request for its return is sent out by the purchasing department.

Copy No. 2 of the purchase order—the office copy—instead of reading as an order, may perhaps state the fact that "An order has been placed with the Johnson Hardware Company for goods as listed below." In addition, as shown in Figure 2, this form may also provide blanks for recording the subsequent transactions relating to the order, such as "Date of Acknowledgment," "Date Goods Promised," "Date of Invoice," "Date Goods Received," "Invoice Approved," etc. When these blanks are filled, No. 2 constitutes a full and complete history of each and every purchase order. This data should be recorded systematically, the No. 2 purchase orders being written up, perhaps once each day, from the accumulated invoices. The office copies of purchase orders should never be removed from the file, reference being made to them, when necessary, in the file.

Copy No. 3 is usually similar to copy No. 2 as to its printed wording. It really requires no special data, save under the one head "Date Promised," as it is placed on the unfilled order file only, serving there as a memorandum and a reminder of the order until the goods are received. At that time it is removed and attached to the invoice, or is otherwise disposed of according to the system in use. In case orders are but partially filled, and the remainder of the order is to come later, the received items may be checked or otherwise indicated on copy No. 3, which is left on the unfilled or-

ders file until all the goods it calls for have been received, or until the unfilled items have been cancelled.

Copy No. 4 is for the receiving department and its printed matter is usually worded as a notice to the receiving clerk that the articles listed on the order should be received from the concern named, on or about the specified date. On this copy a short-width carbon may be used so that while the items show, the quantities of these items do not. This forces the receiving clerk, in order to complete his record, to actually weigh, count, or measure all goods received, instead of taking his quantities from the purchase order.

Copy No. 4 may, if desired, have upon it a certificate to be signed by the storekeeper—or by the foreman in cases where goods are delivered directly to the department for which purchased—stating that the goods have been received. The final resting place of copy No. 4 will depend upon the system in use.

§ 39. Material Stores Ledger.

The Material Stores or Stock Ledger (Figure 50) is a perpetual inventory of material. It is in practice a record of all material coming in and of all issues of this material. It provides for an account with each kind, grade, style, or size of raw material carried in stock.

The department in which the Stock Ledger is actually kept is not a matter of great moment, yet it will usually be found desirable to have it in close proximity to the purchasing department so that it may be referred to readily. There is no established form and shape for this ledger. In some few cases a bound book can be used to advantage, but where the various shapes, sizes, weights, and numbers of units run into the thousands, the bound book is prohibitive and in its stead either the loose-leaf ledger, or cards must be used. Under ordinary circumstances the latter are preferable for convenience and quick handling.

If cards are adopted, stringent rules must be observed as to their use, for while cards are good servants they are notoriously bad masters. When a card is removed from the files, a dummy showing when and by whom the card was removed should invariably be left in its place. If a card is kept out too long it should be recalled. If some such system is adopted and rigidly enforced, the installation will be successful, but if a haphazard, happy-go-lucky use or misuse of the cards is permitted, misplaced cards, lost time, and damaged tempers will be the sure result. Properly used, the writer strongly advocates cards, but unless these are effectively safeguarded the loose-leaf ledger is preferable.

The detailed information record in the Stock Ledger covers "Material Received," "Material Issued," "Balance on Hand," and "Material Ordered." At the bottom of the card—if a form of card ledger is used—space is usually reserved for names of commodities, the minimum number or quantity of the particular article or material to be carried, data concerning size, location, etc.

Under "Balance on Hand" appear columns for date, quantities, average price of units on hand, and total cost or value. Two additional columns are sometimes added with the headings, "Verified by Physical Count" (to be answered by date of verification), "Amount of Difference" (over or under). The Stock Ledger is usually "ruled down" monthly and balances on hand recorded.

The "Material Ordered" columns can, if desired, be arranged so as to show date, from whom ordered, requisition number, quantity ordered, price, date received, and quantity received. Items entered under the head of "Material Received" should, of course, agree with the corresponding entries in "Material Ordered" column, save as to cancelled items.

§ 40. Material Ordered.

Copy No. 3 of the purchase order is kept in the "Un-

filled Orders" file until the order is filled or otherwise disposed of. This is for the express purpose of keeping "in touch" with material ordered. If an acknowledgment of an order is not received in due time, or if after receipt of its acknowledgment the goods do not make their appearance on or about the proper date, the matter is properly followed up, and this is all that is usually necessary. In some lines, however, where goods in process are dependent upon the ordered material for completion, it is advisable to keep in much closer touch with the progress of the ordered materials.

Thus malleable castings may have been ordered from outside sources for delivery on a specified date, and it be necessary that work in progress be so "matched" that it will be ready or have reached a certain stage by the time the castings come in. In any such case reports on the castings in progress should be secured from the foundry at such intervals as will serve to show at any time the stage to which the castings have arrived. This makes it possible to avoid unnecessary and unreasonable delays, and to so arrange matters that the work as a whole will proceed to the best advantage.

Very simple forms will serve for the notation of progress on ordered goods. In many cases slips suitably headed will be found entirely sufficient. Thus in the case of the castings, two report slips headed respectively "The following patterns have been ordered put in the sand for number of castings indicated," and "The following castings have been placed in the annealing oven"—might be all-sufficient.

An excellent form of more permanent casting record for "progress" information is shown in Figure 51. A page or more is given to each pattern number. The number of castings of the particular pattern ordered and the date of such order are entered in the proper column. As reports of castings made are received from the foundry, they are entered under the proper pattern number in the "Foundry Record" group, this showing date, number cast and balance to be cast.

As the castings go to and come from the annealing oven, they are entered under "Annealing Record" in the proper columns. As finished castings are received from the foundry the date and quantity are entered in "Deliveries" column. The "Foundry Record" column will, after each entry has been made, show the balance remaining to be cast, "Annealing Record" will show the number of castings still in the oven, and the final column, "Total Due," will show the number still undelivered.

§ 41. Receiving Material.

In practically all modern shops two broad rules cover the receipt of materials—

(1) All incoming goods must be weighed, counted, or measured in order to determine beyond doubt that such goods are actually received.

(2) Incoming goods must without undue delay be placed in the proper storage compartments.

All of this seems very simple and should be simple; yet in twenty-five shops there will be found perhaps twenty different general plans for receiving goods, of varying degrees of complexity and efficiency.

But little need be said of the physical operations involved in receiving goods. Conditions are so different as to make specific rules inapplicable. One shop may be so located that local delivery wagons may appear at any hour of the day. Another may collect all "L. C. L." freight and packages with its own wagons at certain intervals each day. Yet another shop may be far distant and be accessible only by rail shipments. Whatever the conditions, however, it is a foregone conclusion that to insure accuracy the goods received must at some time and place be counted, weighed, or measured, must be properly stored, and a record be made of their receipt.

Every care should be exercised to insure accuracy in the count of incoming goods, for the tendency to carelessness and loose methods is great. When goods are received

just about closing time the temptation is strong for the receiving clerk to take chances on the seller's accuracy at the expense of "the company." Or if the selling concern bears a fairly good reputation, there will be a disposition to accept a long or involved invoice as correct without positive verification.

A simple method of safeguarding deliveries is found in the use of copy 4 of the purchase order (Figure 45) filled out, as already suggested, by means of a short carbon, so that while the goods to be received are shown, their quantities are not indicated. This gives the receiving clerk all that it is actually necessary for him to know; i. e., that certain goods are expected at a certain time. Then, when the shipment is received, he cannot avoid the necessity of verifying the quantities by an actual physical weight, measure, or count, since his report giving the number, weights, or amount of the goods received goes directly to the office to be checked from the complete duplicate order filed there. The mere knowledge that his report is thus checked is an all-sufficient stimulus to the watchfulness of the receiving clerk, since any carelessness on his part is quickly discovered and brought home to him.

§ 42. Carload Weights.

Where goods are received in carload lots and track scales are accessible at the receiving point, it is good practice on all classes of freight to compare the carload weights, less the tare or light weight on the empties, with the invoice or detailed weight of the contained goods. Probably this is done as a matter of course in the case of bulk goods, such as coal, lime, and salt, but the comparison is not always made in the case of commodities where the specific weights of the articles composing the shipment are given or may be ascertained. Yet it should be done as an additional check on the accuracy of the specific weights. The sum of the parts must equal the whole, and if the carload weight less the tare does

not equal the total detailed weight in the case of any particular carload of goods, an error somewhere is indicated. Incidentally, these "check" weights oftentimes disclose freight overcharges.

Where carload shipments are frequent, a record of cars received, or "Car Book" (Figure 47) is very essential for accurately recording and checking transportation charges and for preserving connected information. In addition to the columns shown in Figure 47, columns for "Gross Weight," "Tare," and "Net Weight" will be found advantageous. The keeping of this record usually devolves upon the receiving clerk.

§ 43. Railroad Car Ledger.

When carload shipments are frequent the work may be expedited by instituting a Railroad Car Ledger or "Car Initial Ledger" (Figure 48). It should be a specially prepared book with space at the top of the page for railroad names or initials, and columns thereunder for car numbers and necessary data. Other headings than those indicated in Figure 48 will be used as dictated by conditions.

The accounts in the Railroad Car Ledger are headed with the names or initials of the railroads whose cars are received. Under these headings are entered the car numbers and other data relating to cars as they come in, the entries being made in such manner that quick reference may be made to any particular car. The intent of this record is not inimical to the railroad companies in any way. It is merely designed as a check on shipments, so that these may be located, when desired, with the least possible trouble and delay. The book is used almost entirely for identification and location of shipments, though information for other purposes may occasionally be included to advantage.

§ 44. Car Number Index.

The Car Ledger to be of value must be so indexed that

the entry of any particular car may be found easily and quickly. For the purpose of indexing the Car Ledger a separate book—the Car Number Index (Fig. 49)—is usually employed. On each page of this book figures from 1 to 1,000 are printed in columns, sufficient space being left to the right of each column for the insertion of folio numbers. When a car is entered in the Railroad Car Ledger, the number of the page on which its record appears is entered in the Car Number Index opposite the number of the car; or the initials of the railroad to which the car belongs may be entered opposite this number.

The page number of the Index stands itself for the thousands in the car number. Thus if a record is to be made of car No. 47,405, its entry in the Index will be made on page 47, and on this page, opposite the printed number 405. The entry is the page of the Car Ledger on which the record of car No. 47,405 appears, or otherwise the initials of the railroad to which the car belongs. In either case reference is readily made to the page of the Car Ledger in which the record appears.

If a car is received more than once, its folio number or a distinguishing initial is entered against its number for each time it comes in, the later numbers or initials being perhaps dated. The chances are, however, very small of the same car coming back repeatedly, unless it be on some short-line railroad where local cars are run back and forth at short intervals. In such case special provision may be made by using more than one page in the Car Ledger for this particular short-line railroad. The same number with different initials—that is, cars from different roads bearing the same number—will be recorded more frequently than return trips of a certain particular car.

CHAPTER VI.

CARE AND ISSUANCE OF MATERIAL.

§ 45. Safeguarding Funds and Stores.

The logic is not clear but the fact is patent, that while manufacturers put their financial officers under heavy bonds for the safety of funds entrusted to their care, they are apt to ignore completely the waste of good material—oftentimes wanton—which goes on day after day within range of the manager's vision.

We may perhaps find a manufacturing jeweler guarding his store of precious metal closely, but he does this because of its high intrinsic value and the ever-present resulting danger of theft. This is, of course, always to be guarded against, but theft is not the form of loss most to be feared in the ordinary factory. It is waste through spoilage, misplaced supplies, improper exposure—in other words, losses arising from carelessness and indifference rather than from dishonesty.

Dishonesty has its place. Raw materials, particularly of the more valuable kinds, are despoiled by petty theft, but the larger losses come through careless handling or careless keeping. Material in stores is lost, improperly issued, spoiled by improper exposure, destroyed by careless handling, forgotten and overlooked. Material in process is lost or destroyed with the same careless indifference or—a costly leak when not prevented by proper controlling records—is made up for stock, stored away, and then overlooked at the time when wanted. Frequently the wastage from material lost or spoiled is not so much in the intrinsic value of the material as in the workmanship and expense already absorbed by this material—

a fact frequently lost sight of in plants lacking a cost system.

§ 46. Cash Audits. Material Audits.

All business is a conversion of assets, which usually has for its ultimate purpose a final exchange into the asset with which the process ordinarily starts; i. e., cash. If the business is successful the amount of cash realized on the completion of the cycle is greater than the amount of cash originally invested; but in any stage of the process the values on hand, whether material, machinery, labor, overhead expense, etc., etc., are merely cash in another form and, within reasonable limits, should be guarded with the same jealous care. As a matter of fact, in some modern factories material is almost as closely checked as cash. A similar close checking of material is sorely needed in many other factories.

A fundamental principle of the modern cost system is the maintenance of a Stock Ledger such as is commonly designated a "Perpetual" or "Going" Inventory (§§ 27, 28). This is on the assumption that material is valuable, just as cash is valuable, and is to be guarded in the same general way. If the stock on hand does not agree with the stock that should be on hand as shown by the records, the reason for the discrepancy is to be discovered and the necessary steps be taken to correct this discrepancy and prevent its recurrence.

Such differences may result from any one of a dozen different causes and some of these may not be preventable; but every one of them increases production cost, and the manufacturer should have the fullest information in order to cut off those that may be avoided and to make due allowance for those that cannot.

§ 47. Locating Leaks of Material.

The Stock Ledger properly maintained is the most effective and ever-present method of detecting losses of material.

Some of the sources of loss have already been referred to; i. e., wastage, spoilage, and pilfering. A not uncommon variation of this latter method of loss occurs where material is taken by the workmen to replace spoiled parts, these spoiled parts being concealed, destroyed, or otherwise disposed of.

As a concrete illustration of a loss of this kind, the author may instance a certain machine shop to which his work had called him. The shop in question is situated upon a canal, from which at the time, the water was being drawn. To the astonishment of the management, as the water receded and the canal bed was gradually disclosed, an impressive collection of machined steel castings made its appearance. The castings were in various stages of completion, but all spoiled by carelessness or poor workmanship and deposited in the canal as a safe and convenient method of disposal. New material had been, of course, taken to replace the spoiled parts.

Occasional causes of loss—very difficult to locate—are due to irregularities in the purchasing department. Perhaps the commonest cause of such losses is the dishonest, or—more mildly expressed—improper practices of the purchasing agent.

Losses of this nature are not disclosed by the Stock Ledger and can only be prevented by the employment of men of a high standard of business morality. Other losses in the purchasing department will for the most part be shown by, or be prevented by the Stock Ledger.

A case known to the author illustrates the close checking of the Stock Ledger. A receiving clerk had been defrauding his concern by collusion with the drivers of delivery wagons. Goods would be received, weighed, and receipted for in due form. Then, his duty done, the receiving clerk would deliberately throw back on the wagon one or more packages of goods. A running stock account was installed while this "irregularity" was in process. The discrepancies when its balances were taken quickly aroused suspicion and finally led to the apprehension of the culprit "red-handed."

§ 48. The Functions of the Stock Ledger.

The details of a properly maintained Stock Ledger may at times seem tedious, and tangled with much red tape. While this is so, if the methods are right it is red tape that holds substantial values from dissipation—red tape that is worth while. When material is closely accounted for by a Stock Inventory, improper disappearances, waste, or spoilage of raw material are quickly discovered, and finished or semi-finished goods cannot be overlooked. The Stock Ledger will show any discrepancies in material as clearly as a customer's account will show a debit balance. The Stock Ledger will also show just what amount of money is tied up in raw materials, in goods in process, and in store stocks.

To reap the greatest benefits from the Stock Ledger it must be kept continuously and systematically. The Stock Ledger is not merely a means of keeping track of stock. This is an important function, but beyond this it will enable the manufacturer to adjust his stock to his needs so that the capital tied up in stock is reduced to the lowest safe figure. Also, if properly kept the Stock Ledger will enable the manufacturer to take monthly inventories, approximately correct, and prepare profit and loss statements each month showing accurately the progress of the business.

The first function of the Stock Ledger is, however, the conservation of material—a function of sufficient importance in itself to amply justify the maintenance of the record. Not only does it effect a large, direct saving in stores, but it is also true that in shops where material is most carefully accounted for, losses from scrap and waste are always proportionately light and the general appearance of the shop the best.

Finally, it may be said that a dollar is a dollar to the solvent manufacturer, no matter what state it be in—money, accounts receivable, goods in store, or goods in process. Workmen do not, as a rule, have the same wholesome respect for twenty dollars in the form of castings that they have for

twenty dollars in the shape of a gold piece, but there is no difference in point of value, and while the same kind of care is not required for each, it will not be disputed that proper factory management will conserve the one as carefully as the other. For the record of the one the Cash Book is employed; for the record of the other, the Stock Ledger. (See also §§ 27, 28.)

§ 49. Storage of Material.

Any and every shop, no matter whether small or large, should, as a matter of system and convenience, have a series of designating numbers and letters for the various buildings, departments, sections, etc., in which material is stored. If a cost system is installed such designations are almost imperative, as the location of material to be shown in the stock ledger sheets must be concise and accurate. Thus, the locating entry for certain goods "in material shed, east of blacksmith shop, near third pillar on right-hand side, fourth shelf from bottom," has the merit of accuracy but is lacking in conciseness.

The simplest plan of designating the location of material is to distinguish the buildings in which it is stored by number, and divisions of these buildings by capital letters. For sections of divisions, numbers may be again employed, and drawers, shelves, or compartments therein may be designated by single or double small letters. When this is done the entire designation may be clearly and tersely stated—as for instance, "5D19h" indicates that the particular material is in building 5, division D, section 19, and compartment h. Where a Stock Ledger is kept for a particular store-room the "19h" may be sufficient, but the full location is generally preferable, especially when a card system is used, as the identification is positive and complete.

In buildings where there are no pronounced structural lines of demarcation, and the material is too cumbersome or in too large quantity for racks, as for instance in the case

of an open building used for storing piles of lumber, pipe, angle iron, round iron, shafting, etc., the material may be laid off in rows with aisles preserved for passage of trucks, etc. If there are two aisles running the length of the building, as is commonly the case, and each aisle has a row of material on either side, making four rows all told, then the various rows may be designated by capital letters, these rows taking the place of the lettered divisions under the arrangement already discussed. Designations should be indicated by means of printed or painted signs sufficiently large and conspicuous to be readily seen. Such signs may be attached to posts at frequent intervals, or may be suspended by wires from the roof.

Where the material is stacked in rows, these may be divided into sections, designated by figures carved in the floor, or metal figures which are usually most conveniently attached to the floor. Or figures may be punched out of cardboard by a stencil-cutting machine and be tacked on the floor, care being taken that they are far enough back to clear passing truck wheels.

If there are racks for the disposition of materials these racks usually afford a place for painted signs to be used to advantage.

When open spaces in yards are used for storage of material, as much care should be exercised as in a building. Avenues should be laid off, sign posts prepared, and the goods be systematically disposed of so that the space does not have the appearance of a junk shop. Even though it be in reality akin to a junk shop, the goods will present a much better, and, if finished goods, a more saleable appearance if neatly arranged.

§ 50. Lost and Stolen Goods.

When goods are paid for but never received, it results in an increased production cost. In plants where but one line

of goods is produced and the cost accounts are limited and consist mainly of "Material," "Labor," and "Manufacturing Expense," with perhaps a few subdivisions under each, such losses are a direct charge to Material Account and would probably never be discovered. Even in plants where specific costs are found and a going inventory is maintained, goods billed but not received sometimes slip through the Stock Ledger. In such case the cost of the missing goods will not show against any specific shop order, but the loss has been incurred just the same, and when an inventory is made of the particular class of goods, and this inventory is compared with the record of the Stock Ledger, the shortage is uncovered. The accountants may never be able to ascertain just how the difference occurred, but the loss is there and must be spread over product in some way, most satisfactorily by including it in diffused expense.

An account designated "Variation of Weights and Measures" (§ 156) is the barometer of inaccuracy or dishonesty, which shows the loss on goods missing, stolen, or not received. To this account all such differences are charged as they are found. The corresponding credits are absorbed in manufacturing expense each month. If the charges to Variation of Weights and Measures run too high in volume, the fact indicates a sharp need of readjustment somewhere—probably in the clerical machinery.

§ 51. Purchase Analysis.

When a cost system is to be installed in a going business, some plan of recording purchase invoices will usually be found already in operation and this may perhaps be made available in the new installation. If not, the plan in use must be changed to one not necessarily more modern, but dovetailing in better with the proposed plan of cost accounting.

A Purchase Analysis Book (Figures 52-66) will be found advantageous for the record of purchase invoices. The

detailed arrangement of this book must, of course, be adjusted to fit the individual needs of the particular business. Figures 52 and 53 show a page of a good Purchase Analysis Book for a machinery business, which will serve as a model for any other business of the same general nature. Figures 59, 60 show a purchase analysis form suitable for other lines of product. The grouping of the columns in the forms shown in Figures 52, 53 is in accordance with the chart shown in Figure 1 and is so arranged that the totals of each group may be carried to the General Exhibit (Figures 204-210).

Freight bills to be paid are entered in the Purchase Analysis Book. The amount of the invoice is included in the totals of "Accounts Payable" column.

The large proportion of material purchased is usually for stores; hence the most active columns of the Purchase Analysis will be those under "Store Room, Dr." Items of expense (supplies), either manufacturing or commercial, will be next in activity. In some factories all materials and supplies are taken directly from stores, and there are seldom if ever any outside purchases of either material or expense items to be directly applied to production order numbers. In other plants, outside purchases of material and supplies for direct use on production order numbers are of frequent occurrence. This is the case as to material where attachments and patented parts made elsewhere have been specified and must be used, and as to expense items, when nickel-plated parts, special name plates, etc., etc., are called for and these are not made by the concern itself.

Where purchases are made for individual order numbers, the charges will be made in the Purchase Analysis under "Goods in Process, Dr." and from such purchase analysis entry the items will be posted directly to the individual order, or to the Production Register (§ 214), according to the plan followed in the particular plant.

All classifications not specifically provided with columns

will be handled through the "Other Accounts by Name" columns.

The column headed "Record of Payment" obviates the necessity of posting invoices to a purchase ledger account. When an invoice has been paid it should have set opposite it in the Purchase Analysis Book the number and date of check by which it was paid. When this is done it is easily possible by a scrutiny of the Purchase Analysis Book to cull out and list the amounts of unpaid invoices, the total of which—together with any unpaid accounts payable carried on the Ledger instead of the Purchase Analysis—will, or should aggregate the balance shown in the General Exhibit (Figures 207, 208) under the column headed "Accounts Payable."

§ 52. Issuance of Material.

When a system of cost accounting is in use, an accurate record of the issuance of material is extremely important, and the physical issuance as well as the record of such issuance should be under the immediate supervision of experienced clerks. Where possible, all materials and supplies should be under lock and key, or at least under most careful surveillance, and be removed from stores only by the proper clerk or official.

It is not, of course, absolutely essential to accurate cost-keeping that a separate store-room be maintained for material, but where this is possible it will be found advantageous. If no separate store-room is maintained, the entire factory can be considered a gigantic store-room and the routine of issuance be conducted just as though the goods were all under lock and key; i. e., for all material used a requisition or stores order (Figures 16-19, 67-79) is to be issued and passed through the regular channels. It is obvious, however, that when material is open and any one may walk up to the bin and help himself, there can never be the same accuracy in accounting as where the material is under lock and key. Even

with the best intentions in the world, workmen will forget to record material taken from stock. Not infrequently they will omit the record with intent, considering anything outside of direct productive labor as red tape and an unnecessary evil, to be avoided and its ends to be thwarted, as far as possible.

Also at times workmen will spoil goods in process, and, being human, will endeavor to keep the fact a secret. Where a new supply of raw material is at hand accessible to any one, this is easily done. Then, as already discussed (§ 47) some disposition of the old material must be made, and this usually results not only in its loss, but in the loss of the labor already put upon it as well, and beyond this in the overburdening of the new material with the overhead expense which the original material should have borne. Even more important than the money value of the material, labor, and expense lost, is the fact that the volume of factory output has been lessened, the morale of the factory force lowered and its efficiency impaired.

§ 53. Waste.

The prevention of unnecessary waste is an important and even vital feature of low costs and of a full and economical utilization of factory capacity. The only positive way in which such waste may be prevented is through an efficient factory accounting system. This will disclose lost material, poor workmanship, and material spoiled in progress. It will also disclose any wastage due to improper use of machines, indicating the product of each individual machine and showing whether it is operated to its maximum on the class of work for which it was specially built, or whether its capacity is partially wasted by its use for less important work, or work for which it is not so well adapted.

Every factory has its own peculiar "waste centers." Thus the cutting room, where such a room exists, is usually a waste

center, no matter what the goods may be. It is the province of the accounting system to point out these waste centers and show just where the waste occurs. The burden of correction is then thrown on the shoulders of the management. The cost system will disclose the leak but cannot stop it.

§ 54. Spoiled Work.

A full report should be made of spoiled or defective material. An excellent form for this purpose is shown in Figure 149. The form, as shown, is adapted for use in a machine shop, but may easily be modified to meet the requirements of any other line of production.

This report form calls for a specific statement as to the work spoiled, the workman responsible, the department and order number in which it occurred, and the name of the foreman in charge. It also provides for a statement of why the loss occurred, what was done with the spoiled material, and indicates the proper entries for the adjustment of the whole matter.

The lower part of the card, separated by perforations, provides for a full statement of the work spoiled, the department in which it occurred, the employee responsible and the reasons for the spoilage. The upper portion of the report reaches the accounting room in due course; the lower portion is sent to the superintendent for his attention and judgment in placing the blame where it properly belongs, after which it is filed under the workman's number and becomes a part of his efficiency record.

§ 55. Store-Room Requisitions for Material.

Store-room requisitions for material, or "stores orders" as they are termed, are found in many different forms, due to the fact that products and requirements in the different lines of manufacture vary so widely. Thus in one line several months may perhaps intervene between the time the factory

order issues for the building of a given number of units and the time the first unit of a lot is finished. A requisition for material used under such conditions is shown in Figure 75. In other lines, production orders for component parts or elements to be made up for stock are issued as may be necessary to maintain the proper visible supply. Stores orders used under such circumstances are shown in Figures 16, 20, 67-70. Or, again, when the component parts or elements of a machine are in stock, an order for a given number of completed units is practically nothing more than an assembling order. A form of requisition used under such circumstances is shown in Figures 17, 76-79.

It not infrequently happens that a production order is issued for a given number of finished units to be made up from start to finish, save for certain interchangeable parts which are usually made up for stock on separate production orders and requisitioned as needed. It sometimes happens that the stock of these parts is exhausted at the time the unit order is to be put through. In such case two courses may be pursued. Just enough of the parts may be made up for the immediate unit order, in which case the parts are included as part of this order. Or a full supply may be made up for stock, in which case they are either made on a separate order number or are included in the unit order number and the surplus then transferred to stores or to another order number. When this latter course is pursued, the "Transfer between Order Numbers" (Figure 157) may be used.

When parts are made up on a separate order number they are, when finished, credited to "Goods in Process" and charged to "Semi-Finished Product." Semi-finished product is carried in the stores department and on the records in the same manner as raw material, and is issued upon the usual requisition or stores order. The charges for raw material furnished for production orders covering semi-finished product are handled in the same manner as similar charges to

production orders which cover completed product. The synthetical or controlling record is found in the Production Order Register under "Raw Material" in both cases. The analytical record is found under the respective order numbers, either in the form of individual entries on the Production Order Register or in the items of the material requisitions bearing the number of the particular order.

§ 56. Routine of Requisition.

The requisition form for issuance of material to be used in parts, is preferably a large-sized tag (Figures 16-19), numbered and perforated to permit the easy separation of its coupons. The upper portion has space for date, order number, name of part, and any other relevant data that may be desired, while the lower portion or coupon is a requisition for the necessary material. This requisition coupon in its simplest form is merely the order number followed by a list of the articles or materials required, and is detached by the storekeeper when he issues the specified materials.

The items of these coupons or requisitions are listed, by order number only, upon a form known as the "Material Coupon Summary" (Figure 81), having columns as may be demanded by the particular system employed; as, for instance, "Order No.," "Goods in Process, Dr.," "Store Room, Cr.," the latter having as many subheads as may be desired, these representing the various groupings into which material is divided in the particular plant. The form shown in Figure 81 is grouped for a metal-working plant.

The storekeeper may for his own protection, retain a carbon copy of the store room coupon analysis, if desired, but the original, together with the coupons, is sent to the cost department where the individual items appearing upon the coupons are entered upon the Stock Ledger (Figure 50) at cost. When all the items have been posted, extensions are made at

the prices shown by the Stock Ledger and these extensions are entered on the coupon analysis.

Each coupon is then filed away under its shop order number while the clerk in charge of the coupon analysis ascertains and enters the footings of its various columns, and prepares its data for entry upon a "recapitulation sheet"—similar to the coupon analysis in its general form—through which the figures find their way to the General Exhibit (Figures 204-210). The total of the "Goods in Process" column is passed to the debit of "Goods in Process Material" on the General Exhibit, while "Store Rooms" gets credit for a like amount. The analysis of the material grouping does not ordinarily appear on the General Exhibit, being maintained by means of the recapitulation sheet.

Charges to the individual factory order numbers on the "Production Register" (Figures 25-39) are usually made from the coupon analysis by posting the items appearing against each successive order number in the "Goods in Process" column.

The analysis of material on the coupon or requisition form of Figures 18, 19 can be varied to suit the needs of the individual plant. Where there are several different forms used for drawing material or finished parts from stores (Figures 67-70, 76, 79), these different forms may be distinguished by form symbols or letters, and the "summary sheet"—which is merely a more elaborate form of the coupon analysis—shown in Figures 82, 83, is so arranged as to indicate by check marks the identity of each withdrawal requisition. This feature is important to the storekeeper as when the requisitions (cards or tags) leave his possession, his only evidence of the transaction is his carbon copy of the coupon analysis or summary sheet.

When detached departments have stores close at hand or have individual store-rooms, and goods are withdrawn by or under direction of the foreman as occasion demands, then

a special form (Figure 72) may be used to advantage, such withdrawals being reported to the main office once a day, or once a week, or as often as a sheet is full, provided it does not overrun the current cost period.

When the factory order for semi-finished product (Figure 10) is completed, the lower portion of the tag is detached, listed upon a store-room report such as is shown in Figure 80, and returned with the report to the cost department. Here the report goes first to the order clerk, who enters "Total Finished" on his Production Register (Figure 25) and places a check mark on each tag, to indicate that such entry has been made. The store-room report next goes to the cost clerk, and as soon as all time and costs are in for the various items on the sheet, the proper amounts are entered on the cost records, and the sheet is totalled and sent for entry on the General Exhibit, preferably through a recapitulation sheet. "Semi-Finished Product" will be charged with the footing of the total cost column, and "Goods in Process" will be credited with the same amount under "Material," "Labor," and "Expense" respectively. Either before or after entry on the General Exhibit, the store-room reports go to the stock clerk and the individual items or parts are posted to the Stock Ledger.

In the case of material and parts for an assembling or completing order, the larger form of requisition shown in Figure 75 will be found more suitable. This form is usually a detailed list of the component parts of the product and of the items used in connection with it, the parts frequently numbering as high as fifty or even more. The items required are indicated by entering against them under the heading "Quantity" the number required. These entries are made in the cost department. One copy of the requisition is filled out complete and sent to the store-room, and another copy, filled out only with the shop order number, is retained in the cost department binder with others of its kind.

The storekeeper can check from this form the tags for finished parts (Figure 10) as these finished parts are received by him, if they have been made on separate orders. One or more times during each month or four-week period the storekeeper's binder can be sent in to the cost department, and those articles which have been checked off as material issued can be copied, extended and totalled so that the General Exhibit will show the material that has been credited to the store-room and charged to "Goods in Process."

For issuance of material to replace spoiled parts, any ordinary form of requisition blank may be used, such blanks being listed on a "requisition analysis" (Figures 81-83).

CHAPTER VII.

APPLYING COST OF MATERIALS.

§ 57. Methods of Applying Material Costs.

Applying the cost of material which enters into a manufactured product is a simple matter. There are many plans for doing this, varying as to detail but all capable of being brought under the two following general methods:

(1) Order Number Charges. Under this method the quantities and values of material actually drawn from stores or purchased for a specific order number are charged to that order number.

(2) Departmental Charges. Under this method the quantities and values of material actually drawn from stores by or purchased for a certain department are charged to that department. Thereafter the department is credited with the amount of material actually used in its operations, the difference between these debits and credits showing the material which should be on hand in that department.

In the department the costs of materials are charged to the specific order number for which they are used. As will be seen, the only difference between the two methods lies in the fact that under the first method materials are charged to the specific order number direct, and under the second method they are charged to the specific order number through the department, the actual charge to the order number being made in the department.

§ 58. Scrap Material.

Frequently scrap or waste stock is utilized by being made up into parts or even small articles; as for instance, wood-

room scrap is made into drawer pulls, rolling pins, and bread boards; clippings from sheet iron and steel are made into small patterns; short lengths of bar iron and steel are made into nuts and bolts, braces and wheel spokes.

This use of scrap brings up the question, What material costs shall be applied to articles made out of scrap? Shall the material be charged at the original cost of the material, or shall it be charged at its scrap value? Thus a case in point—wood-room scrap in a certain factory was used in the construction of a cheaply made wheelbarrow, and the question arose as to what cost for material should be applied against the barrow. Should the scrap be charged at full lumber value or at its value for scrap?

The respective arguments are, on the one hand, that the price actually paid for lumber less the ordinary percentage for scrap, is not the proper charge against the shop order in which that lumber is used, when the scrap is utilized for other products in which the material has a higher value than the constituent scrap as scrap. From this point of view, the lumber charge to the original shop order should be decreased and the scrap be charged at full lumber value or such proportion thereof as may seem equitable.

On the other hand, it is argued that as this scrap has already been once paid for by the customer on the original shop order, it costs nothing and therefore should be either treated as nil in the cost records, or be entered at its scrap value. Also it is argued that a product made from scrap is usually marketed at so low a price that if the raw material were charged to it at full lumber cost, the scrap product would in many cases appear on the records as costing more than its selling price.

Logically it would seem that the actual cost to the concern per foot or unit of material should apply to each and every article produced from that material. The author is fully of the opinion that this should be done. Certainly this gives the

most equitable basis on which to calculate the cost of the several articles of product, whether this product be made from scrap or from material in its original condition.

The danger in omitting the charge for material where scrap is utilized, or in charging it on the basis of scrap values, lies in the fact that in possible future reference to the cost price of such jobs, the material element may be overlooked or entered at scrap value, and a price be made on a repeat order that does not include material at its real cost. If scrap were on hand for such a job the quotation would be safe, but if scrap were not on hand it might be decidedly unsafe. The only safe plan is to charge the job with whatever material is used at the going prices for such material.

When scrap material is charged to its product at a higher cost than its scrap value, it is obvious—wastage having already been allowed for on the basis of scrap values—that a greater material cost has been charged into product than is called for by the records. Such variations are best adjusted by passing their amount to the credit of "Variation of Weights and Measures" Account (§ 156), or to the account "Over, Short and Damage" (§ 154), or to one of the corresponding reserve accounts.

PART III.—LABOR.

CHAPTER VIII.

TIME RECORDS.

§ 59. Time Reports.

The importance of accurate time reports cannot be emphasized too strongly, for without them accurate cost finding is impossible. If less time is reported on some particular job than was actually consumed, then some other job has to bear the burden, and the findings of the cost system are false and misleading.

The time reporting system, whatever its precise form, should show the total hours of labor expended on each individual order number and also the total of each day's labor. The number of hours devoted to each separate order number is a prime necessity for the distribution of manufacturing expenses. The total of each day's labor is necessary for entry on the General Exhibit (Figures 206, 210) where it is debited to the proper controlling accounts—which are for productive time, "Goods in Process—Labor," and for non-productive time, "Manufacturing Costs,"—and is credited to "Accruing Pay Roll."

Time reports vary widely in form and in method of use. Under some conditions individual job cards are used to report the time expended on each separate order number. In this case the time of employees between "in and out" not reported on their cards, represents the time lost between jobs. Under other conditions time cards are used which show the

disposition of the employee's time for the entire day, idle time being shown, as well as active working time.

§ 60. "In and Out" Time Register.

An "in and out" time register or record is convenient but is not a prime necessity of a cost system, especially where a clock or stamp is used for recording time on individual job orders. If time cards similar to any of those shown in Figures 96-99, 101, 102, 106, 107 are used, no further "in and out" time is necessary.

Where the "in and out" register is in use, tardy employees may be required to report to a clerk entrusted with the duty of reporting tardiness, and this record may be turned in daily to the cost office. Where an employee stops before the regular time for closing, this fact should be noted by him on the last time report made for that day. In either case, the explanation is merely for the information of the cost department, as the employee can have credit on the pay roll for only such time as is shown to be due him by his time cards.

This presupposes that each employee's work is planned ahead so that he may turn directly from one job number to the next, stamping or ringing "out" on the first job card and ringing "in" at once on the next. There are then no pauses or lost time between the two jobs—a condition desirable not only from the accounting standpoint but from the standpoint of individual efficiency. If this is not the case, there is "idle time" between jobs which is a direct loss to either employer or employee, depending upon the method of labor payment, the employer suffering to some extent in either case.

§ 61. Recording Time.

The most efficient form of time report is one on which both the beginning and finishing time is recorded by a clock or time stamp. This records the facts and precludes the

falsification and evasion possible under almost any other conditions.

Where the time register is not in use, time reports must be made out by hand. There are many forms of time reports adapted for this use, ranging widely in scope and character. Some of these are reproduced in Figures 115-122. Those shown are all good forms for time recording, and any one of them may be used to advantage under the conditions for which it is adapted. The choice will depend entirely upon the requirements of the cost system in use, as the time record must, of course, "dovetail" with the general plan of cost accounting.

In some shops a timekeeper constantly circulates among the employees and records each change of job. Where this system is in use, the cards or report forms shown in Figures 128, 129 may be used to advantage. In other shops the foreman is directly responsible for a proper record of time and makes the time reports himself as the employees report to him—a modification of the timekeeper plan. Neither the perambulating timekeeper nor the recording foreman plan is to be recommended. In either case the workmen are required to remember the time they finished one job and began another and report this. In nine cases out of ten it will be found that they make a pencil memorandum of the "times" to be reported, and if such a record is to be made it would better be made on the final time report than entered as a merely preliminary memorandum.

It may also be said generally that it is not advisable to make bookkeepers out of shop hands. This is especially true where the class of help employed is illiterate. In such case any record to be made by the men should be made through the medium of some modern and effective time recorder. Then the act required of the shop hands is merely automatic and the time is recorded accurately and easily.

§ 62. Using Time Reports.

"Filling in" is, of course, necessary in any form of time

card. In some factories the foreman or a clerk makes out the body of the time card, leaving the starting and stopping time to be filled in by the workman. This latter is probably the best method under ordinary conditions, especially where time recorders are used, as the employees are not then called upon to use any brain capacity whatever in the handling of their time cards. The time recorders do this for them. When enough registers are supplied so that the men need go but a short distance to reach them, less time is required to make this accurate and desirable form of record than is required by the average shop hand to himself laboriously write a more or less inaccurate record on the card.

As the job cards receive the final stamp or record they should be dropped into a locked box near the time recorder, from whence they should be removed at least each day by a cost department clerk.

When a machine is under construction it is advisable in almost every case to work out costs on individual parts rather than to take the machine as a whole. In fact, the cost in its truer sense is not known unless the costs on individual parts are known. Where costs are worked on individual parts, the various parts being made contemporaneously, the shop order can apply to the entire machine or other article, while the various parts can be made under separate or sub shop orders, the common order number being used in connection therewith. This plan insures the proper segregation of the time reports under the common shop order number, both for parts and for the machine or other article as a whole, and yet the details of work on the parts are presented in such manner that the information may be effectively classified.

§ 63. Forms of Time Reports.

Time cards for use with time recorders are shown in Figures 96-110. A common form of time card where time

recorders are not used, has a list of different operations printed on its back, the employee indicating the work he has done by a check mark against the proper operation, thereby saving the necessity of writing it out in full. Included in the printed details of this time card are clock dial imprints, and on these the workman checks his starting time and his stopping time. The form is a fairly good one.

Another very good card for use where time recorders are not employed is shown in Figure 115. Here the time space for "On" is subdivided so as to cover the different possibilities. Under the subhead "Begun"—when the card is subdivided as shown in Figure 115—is entered the beginning time; under "Continued," the time work is begun on the succeeding day when no other work has intervened; and under "Resumed," the beginning time when other work has intervened.

Time "Off" is similarly subdivided. On the card as shown, under "Unfinished" is entered the stopping time when work is not finished at end of day; under "Interrupted," the time when employee is diverted to another job; under "Operation Finished," the time when the work under that ticket is finished; and under "Job Finished," the time when the job is complete with no more time tickets to follow.

This same form of card may be used with a time recorder if made sufficiently large to provide stamping spaces under or against the different headings. Or, again, it may be adapted for such use more simply by providing a stamping space under both the heading "On" and the heading "Off," the particular subhead referred to being checked with pencil or indicated in some similar way.

§ 64. Reporting Non-Productive Time.

In non-productive work there should be standing shop orders for the different classes of work; as for instance, "Repairing Machinery," "Cleaning Machinery," "Trucking,"

"Store Room Labor," "Sweeping and Cleaning Shop," etc., etc. For such labor the time report is practically the same as for productive labor, except that a designating color is usually employed as a matter of convenience. Also a color scheme for non-productive time cards may be used to advantage as between different departments. "Non-productive" time reports will not be used ordinarily by producers unless they are on non-productive work for the entire day, non-productive time less than a day being reported on the regular productive form.

§ 65. Decimal System of Time Reporting.

Some few factories use the decimal system of time reporting, under which the clock dial is divided into ten periods of six minutes each. (See Figures 109, 110). These divisions are for the minute hand only, the hour hand remaining as on the ordinary form of time card. The first division, representing six minutes, is numbered "1"; the second, representing twelve minutes, is numbered "2"; and so on up to the ninth division representing fifty-four minutes. If work begins or stops on the hour, the hour alone is checked.

Under this method the six minutes' period is the unit, the "give and take" plan being followed; that is, if the actual time be eight minutes after the hour, the eight minutes are treated as six and the first division of minutes is checked. If the time is ten minutes after the hour, the second division is checked, giving the minutes as twelve. If the time is nine minutes after the hour, the minute time coming in the middle of a division is entered as six minutes or as twelve minutes, according to the general rule adopted. Both time stamps and clock stamps are made for use with this decimal minute system.

§ 66. Time Recording Devices.

The ordinary time clock and time stamp are familiar. The adaptation of these to the decimal system of time record-

ing has been discussed in the preceding section. Beyond these there are at least two time calculating devices on the market which compute and record elapsed time automatically in connection with the act of final registration. Another device automatically computes elapsed time, reduces it to a money value at whatever rate per hour is desired, and registers both the number of hours employed and the money value at the specified rate.

§ 67. "Group" Order Numbers.

Where parts are sufficiently large, or are made in considerable quantities at one time, or where for any other reason the labor expended on them is sufficient to warrant a specific order, they should always be made under a shop order as the best and most direct means of getting at the desired facts. Where, however, a large number of parts go to make up a single article, a system of separate orders and reports on each part is voluminous and top-heavy and the time consumed in recording the labor is not justified by the results.

In any such case, if groups of individual parts go to make up elements and such elements are used in common in different articles, these articles varying as to size or some other characteristic, the elements may be treated as units and be made under independent order numbers. This arrives at the desired facts more accurately than when a single order number covers the entire article and its elements, while at the same time avoiding the multiplicity of reports and data incident to a separate order number for each individual part.

§ 68. Time Reports and the Pay Roll.

The pay roll is made up from the time reports. Its total amount must, of course, exactly balance the controlling "Accruing Pay Roll Account" at the end of the pay-roll period. For pay-roll purposes a coupon time report is convenient (Figures 101, 118). When this is used, the coupons are

detached as filled, each separate shop order is given its proper time charge, and, for purposes of reference, the coupons for each order number are filed under the proper number. At the same time, the stub containing the total time for the day is filed under the workman's number and held until the pay roll is to be made up, when all the stubs are removed and summarized for the pay roll.

A form of pay roll convenient for use with this form of time report is shown in Figure 132. It consists of a master sheet bearing the names and numbers of the employees, followed by such columns as may be demanded by the accounting system in use. This serves for one pay-roll period. For subsequent pay rolls, sheets are provided with columns similar to those on the master sheet. These, used with the master sheet, obviate the necessity of writing out the names and numbers of employees each week. The master sheet serves its purpose until changes among the employees necessitate the preparation of a new sheet.

Six columns will usually be required on the pay-roll sheets, although in small shops or under certain conditions three will answer, especially if there is not much non-productive time. In the first column is entered the total time credited to the employee. The remaining columns show the distribution of this time under the following headings: "Awaiting New Work," "Power Shut Down," "Repairing Machine," "Cleaning Machine," "Productive Work." Where an analysis of total time is made every day from the tickets, the non-productive work can all be totalled in one column and three columns are then sufficient. In cases where frequent deductions are made from employees' pay, the pay roll should be provided with special columns to show these deductions.

In the United States Navy Yards the method of recording time and computing pay rolls is briefly as follows:

"The time is reported daily, by each workman, in the form of an individual time ticket which embraces the labor

performed by each man on a specific job. Separate time tickets are used when more than one job is worked upon during the day. The tickets are approved by the foreman, leading-man, or quarterman, and are forwarded early the following morning to the time section of the accounting department, where they are calculated and proved for each shop on a revised form of pay roll. Daily, they are also balanced with the total wages computed according to the number of employees in the yard, thus keeping an accurate account of the labor expended. * * *

"After the tickets are sorted to jobs, by means of job-order numbers, they are forwarded to the posting section, where they are posted daily, to the respective job orders, by shops."*

The actual payment of wages is outside the province of the cost system, but a rapid method of paying off may be mentioned. A number is assigned permanently to each man. On pay day a long, narrow strip of canvas is stretched along the passage way or space where the men assemble to receive their pay. On this strip are painted or stencilled numbers in serial order corresponding to the numbers given the men, and arranged at such distance apart as to give standing room opposite each number. Each pay-roll envelope bears the name and number of the man to whom it is to be given and these envelopes are also arranged in serial order.

When paying-off time arrives each man arranges himself opposite his number on the canvas. At a signal the line moves. As each man approaches the pay window he calls his name and number and presents his identifying check or slip. As he does so he receives the envelope containing his pay and makes way for the man behind him. Under this plan the men can be paid off almost as quickly as they can walk by the pay window.

* Engineering News.

CHAPTER IX.

THE PREMIUM SYSTEM.

§ 69. The Premium System—Ordinary Form.

The basic idea of the premium system, as it is ordinarily known, is a standard time or rate of production with a fixed wage or payment for this standard of achievement. If the employee falls short of the standard, he is penalized. If he attains the standard, he receives the agreed wage or payment in full but nothing more. If he exceeds the standard he receives a premium or bonus based upon the excess achievement.

Thus, if the standard time for a certain operation is five hours, and the workman by superior concentration, activity, or ability completes the work in four hours, an hour of his time has been saved, and under the plan usually adopted half the price of this hour's work is his. In addition to the saving of time, overhead expenses are likewise saved, but this is not recognized in the employee's compensation, and is, in practice, a clear gain to the manufacturer.

The equity of this division has been questioned, some advocates of the employee claiming that he should receive the entire saving on labor. This is a question for the individual manufacturer and his men to decide. It must not, however, be forgotten that there must be some material inducement to the manufacturer to establish and maintain the system as well as for the employee to work under it. This is so because the introduction of the system involves expense and trouble that otherwise would not be incurred. The details of the plan must be arranged; the standard of production must be established; the employees must be trained to the more

rapid work desired; and closer supervision must be provided to maintain the quality of the work under this more rapid operation.

§ 70. The Bonus System.

A modification of the ordinary premium system sometimes known as the "bonus system," provides for a moderate bonus or premium for small time reduction, and a graduated increase of bonus as time is further reduced. Thus, one such system provides for a 10% increase of wages for a 10% reduction in time, a 15% increase of wages for a 20% reduction in time, and a 20% increase of wages for a 30% reduction in time, etc. The objection to plans of this character is found in the intricacies involved in the calculation of premium earnings. Clerks competent to calculate premium earnings on a 50% basis are legion, while to follow up the more complicated schemes requires an accountant with some of the qualifications of an insurance actuary. The employees are not themselves usually apt at comprehending the complex calculations resulting from these graduated scales of premium, and more or less friction results.

§ 71. The "Stint" System.

Another modification of the premium plan employed in some classes of production is known as the "stint" system. Under this the premium or reward consists of a gift to the employee of all time that may be saved by rapid working. Having decided upon the number of units of output that may be accomplished in one day or one week, a "stint" or "task" is assigned to an individual, or to a gang, with a promise that when the stint is performed the employee or employees will be required to do no more that day or that week as the case may be. Thus, if a gang finishes the day's "stint" three hours before the regular quitting time, the men have these three hours for themselves. Or if the stint was based on a week's

work with the same average saving, the men would have for themselves one and one-half to two full days.

There are some material advantages in this method over the ordinary wage system. Thus, the "off time" affords opportunity for repairing or cleaning machinery without the loss of time that these operations usually involve, and employees are usually more cheerfully ambitious while working, looking forward to the leisure time for their own recreation or affairs. If the method is properly used the men will produce more units of work under it than under any of the regular wage systems.

The "stint" system as compared with the ordinary premium system, has the obvious disadvantage of not yielding the employees an increased income. Also their "idle time" results in continuing overhead expenses while no productive work is going on, since it is impossible to profitably utilize the odds and ends of time gained on the various stints. For these reasons the method is but a short step in the right direction. It will, however, be found a good method to adopt preparatory to the introduction of a premium system, since it tends to show what the employees are capable of doing and thus affords a basis for setting up an intelligent standard. It also familiarizes them with the general idea of a reward for more efficient effort.

§ 72. The Contract System.

The plan known as the contract system is somewhat akin to the list-percentage contract system described in § 73. The two plans differ, however; the present plan making each employee or crew chief a contractor, while under the other plan the foreman is alone a contractor. Under the present plan a certain time limit is fixed for the completion of the assigned task or contract, as in the case of the stint system, and there is a fixed amount paid for the work performed, but as soon as this contract is completed, the contractor may, if so dis-

posed, take on a new contract instead of quitting his work. In some cases the "contractor" is penalized at a fixed rate per hour if his work is not performed within the contract limits.

There is also an element of similarity between this plan and the ordinary piece-work plan, the essential difference lying in the fact that under the contract system the tasks are usually long ones, taking perhaps from one to ten days or more and oftentimes involving a gang of men employed directly by the crew chief, who is known as the "contractor." The payments of money to such contractors are treated as advances until the contract is completed, but inasmuch as it seldom happens that a pay-roll period and the termination of a contract coincide, the pay records of such contractors are merely ledger accounts involving frequently recurring items of debit and credit.

§ 73. Contract System under List-Percentage Plan.

Where the list-percentage system is used, a modification of the usual premium system is sometimes employed—also known as the "contract system," but differing from the contract system just described in the fact that the foreman alone is the contractor and is held responsible for the work of his department.

Under this contract plan the foreman is put in charge of his department on a semi-independent basis. He is to provide labor and is paid on the basis of output. A list of cost percentages is fixed for material, labor, and expense for each product in each of the various departments, as accurately as possible, and the labor percentage determines the credit the foreman is to receive for the output of his department. Thus in department D labor may be fixed at 2.6 of the list price, which figured out may amount to $1.54 per unit. This, then, is the price the foreman is allowed for labor on each unit of the product turned out in his department, no matter what the amount he actually has to pay. If he can turn out his product at a less

cost for labor than that allowed him, the profit is his. For his compensation and further profit he is allowed a drawing account against a percentage on the cost of his departmental output.

Under this system the foreman is virtually in control of his department. He hires his own men, he arranges his work and conducts its operations as seem to him best. He must, of course, conform to the general policy of the concern, must turn out a product strictly up to standard inspection requirements, and is held strictly accountable for the proper general operation of his department and for the maintenance of reasonable costs; but outside of this, his goings and comings and his labor troubles are his own.

It is but seldom that a contracting foreman is personally able to finance his department. Therefore, while he hires his own men, he turns in his report of the amounts due them, at the end of each pay period, and the concern advances money for the pay roll, charging it to the contracting foreman. He is also furnished material; supplying nothing, in fact, beyond labor and supervision.

The contracting foreman is, as stated, allowed to draw a certain amount each month on his personal account, and a settlement of his balance is made once or twice a year. At this time his percentage or compensation is adjusted, if adjustment is necessary, being lowered where the allowance is clearly excessive, and raised where it appears that it is insufficient.

An account is kept on the Factory Ledger with each contractor, and as money is advanced to meet pay rolls or personal items, he is charged with the amount. On the other hand, he is given credit for the allowed percentages on all standard product passing through his department, and an arbitrary or job price for any special work that has no standard percentage, or for any shortages for which no blame attaches to the contractor's own department.

The handling of costs of repair parts, shortages, etc., is of necessity sharper and cleaner cut under the contract plan than is ordinarily the case. Hence, a separate form (Figure 203) is used to properly differentiate the various costs and credits to the contractor.

In conjunction with the contracting foreman's ledger account, a record similar to that shown in Figure 201 should be kept, in order that close records may be made of fluctuations in the foreman's account, and that the reasons for these fluctuations may be discovered.

A broad policy is necessary to the success of the plan. Usually the contracting foreman shares his profits with his men, and he must be allowed to make a fair margin of profit, both for himself and his men. If otherwise, his interest soon lags and he becomes no more than an ordinary foreman working for the stipulated drawing account, and his men lapse into ordinary, indifferent employees, working for a fixed wage. To prevent this, the possible profit should be sufficient to be a real incentive, and, above all things, should be stable. When the earnings are large beyond reason, it is fair enough to cut the foreman's percentages, but they should not be cut so far that the margin of profit is not worth the increased effort necessary for its attainment.

§ 74. Premiums for Quality.

Still another form of the premium system is based on quality rather than quantity of work. Such a system may be used advantageously in the making, for instance, of pearl buttons, the work upon which is done on a basis of avoirdupois; i. e., a given price per operation per pound of buttons produced. A premium rate of perhaps 50% over ordinary piece-work rate is fixed, but the required standard must be maintained in order to earn the premium rate. A system of "docks" is applied for shortcomings. The nature of these

"docks" can be seen by reference to Figure 127, which is an employee's earning record.

To determine the quality of the product and the amount due employees, an inspector takes a carefully weighed ¼-lb. sample out of each lot as he comes to it; one sample, as a rule, being all that is taken from a given lot. This sample is carefully scrutinized, graded, and labelled. Any "docks" discovered are listed on the employee's production report and involve a predetermined deduction from the premium rate.

In work of this kind the number of pounds put through a given machine under either the ordinary plan or the premium plan is approximately the same, but the employees become more rapid and more dexterous in feeding the blanks into the various machines. A larger quantity of first-grade product is therefore produced with a corresponding reduction of lower grade buttons and "rejects" which are of little or no value.

Figure 127 which is discussed on the preceding page, represents a daily report which is made by the individual employee or in some cases by the foreman, the weights being verified and the docks inserted by an inspector.

§ 75. Advantages of the Premium System.

As to the advantages of a well-devised premium system but little need be said. It is the natural method of securing the best effort from employees, for they are paid on the basis of what they do.

The adoption of an effective premium system means not only a materially increased volume of product and a materially decreased percentage of burden, but employees more efficient and contented because better paid.

The results obtained from an effective system of premium allowances are astonishing. Thus a premium system was installed some years since in certain departments of a pork-packing house in New England. Boys had been employed at $6 per week to tie link-sausages—so many boys that they

got in one another's way, yet they could not keep pace with the work. Sausage tying was one of the operations put under the premium plan, and the time allowance per hundred pounds was cut to a seemingly ridiculous figure. For the first two or three weeks the boys could not make more than a quarter of their regular pay, but as time went on, speed was gained, wages increased, and eventually it was found that two boys could care for the entire output and do it better than six boys did before. The two boys earned weekly somewhere near $15 apiece. The actual saving on this one operation can easily be calculated.

Much the same conditions exist in many shops. Machine work cannot, of course, be speeded up as much as is possible in the tying of sausages—an operation depending entirely upon manual dexterity—yet the output on machine work can ordinarily be greatly increased. It will be recognized that machine work can always be so manipulated by the employees as to either make or lose time or product for the manufacturer. Naturally, if it is made worth his while the employee will do all in his power to bring out the best that is in him and in his machine, and the result will be greatly to the advantage of the employer.

In a comparative statement by Mr. Nicholson,* the advantages of the different methods of payment are set forth as follows: "Given a certain productive increase in a factory, and, under the day rate plan, the employer receives all the benefit, while, on the other hand, under piece work, all or nearly all the gain goes to the workmen, the employer saving only in the indirect expense. Under this plan the profit is divided more evenly, each side receiving a gain somewhat proportionate to its interests involved. This can best be analyzed by an arrangement in tabular form.

"Suppose a factory under the day rate system, where the men produce 8 articles in a day of 10 hours at 30 cents per hour. We are to analyze the costs as the production increases

* Nicholson, "Factory Organization and Costs," pp. 23, 24.

25 per cent., or to 10 articles, per day under the stimulus of a new wage system. It is fair to assume that under the piece work plan, the rate would be 32 cents per piece, and under the differential rate plan, 32 cents each for 8 pieces and 34 cents each for 10 pieces. Likewise with the premium plan; let the pay be 28 cents per hour, with a premium of 14 cents for each hour saved.

"It must be noticed that if the workman produces at first 8 articles per day and then 10, he completes his former production in 8 hours and thus saves 2 hours in 8. As the supposition is that his increased rate is constant, this means that his gain in a day of 10 hours is 2½ hours, or 25 per cent., which agrees with his general rate of increase as it should.

"We may assume the cost of material to be 12½ cents per article, and the overhead cost to remain constant at $1.50 per day for a production of 8 articles and increasing $\frac{1}{15}$ or 6⅔ per cent. for an increase of 25 per cent. in production. The increased production is not given for the day rate system, as in the first place the increase would not take place, and, in the second, whatever increase there might be would all go towards the employer's profit. The results obtained under the bonus system are incorporated in this table for future reference. The rate is taken as 28 cents per hour at a production of 8 articles a day, and 32 cents per hour at 10 articles per day.

System	No. of Articles	Rate of Payment	Labor Cost	Men's Gain per Day	Cost of Material	Overhead Cost	Total Cost	Cost per Article	Reduction in Cost per Article	Reduction in Cost for 100 Articles
Day Rate...	8	.30 per hour	$3.00	....	$1.00	$1.50	$5.50	.6875		
Piece Work	8	.32 per piece	2.56	....	1.00	1.50	5.06	.6325		
	10	.32 per piece	3.20	.64	1.25	1.60	6.05	.605	.0275	$2.75
Differential Rate.....	8	.32 per piece	2.56	....	1.00	1.50	5.06	.6325		
	10	.34 per piece	3.40	.84	1.25	1.60	6 25	.625	.0075	.75
Premium....	8	.28 per hour	2.80	....	1.00	1.50	5.30	.6625		
	10	.14 additional for each hour saved	3.15	.35	1.25	1.60	6.00	.60	.0625	6.25
Bonus.....	8	.28 per hour	2.80	....	1.00	1.50	5.30	.6625		
	10	.32 per hour	3.20	.40	1.25	1.60	6.05	.605	.0575	5.75

" * * * Naturally, in a table similarly arranged, taking the data from actual experience in a factory, there would be considerable change in the several items, but it can be confidently asserted that the table, with its results, is relatively true. It then follows that the advocates of the premium plan have a very good basis for the claim that by this way the profits accruing from increased production are more equitably divided between the employer and the labor employed."

§ 76. Operation of the Premium System.

The practical operation of the premium system is well set forth in the following paragraphs paraphrased from the testimony of Mr. Emerson before the Interstate Commerce Commission.*

A casting that ought to be machined in three hours comes in, and it is perhaps a very hard casting and takes twenty hours or more to machine. Under the old system the man in charge was entirely contented. It was easier for him. He stayed there and watched his machine take off those fine hair cuts—and all was peace.

Under the new system it is very different. Machining of this nature is scheduled at three hours. It took the man twenty-three hours to machine his casting. He was losing out on his efficiency and on his efficiency reward. This was not to be endured and a prompt appeal was made to the foreman. The foreman came around in a hurry to see what could be done. He was losing his efficiency on the man and that was not to be endured. He found that he could not do anything. So he hurried off to the superintendent, reported the conditions to him and asked what he should do about it.

The superintendent investigated and found the castings were hard. "I will put them in the big flange furnace and anneal them and soften them." So he put them in the big flange furnace and tried to anneal them, but there was manganese in the steel and it did not soften.

* Record, pp. 3588-3592.

At this point, the superintendent having reached the end of his resources, came to Mr. Emerson for help. Mr. Emerson said: "The proper thing to do is to have a special time study made for those thirty-five castings. They are special castings, much harder than the normal. You have an entire change of conditions. Go in and make a new study and make it date back to the first casting." So a new study was made and the time was settled for those particular castings at twenty hours.

The man after that attained his twenty hours and was contented. The foreman was no longer losing efficiency on the job and he was also contented. The superintendent was not so well contented for Mr. Emerson said to him: "You don't get out of it so easily. You are going to be charged up with seventeen hours loss upon each one of these castings. That is sheer waste and should not have occurred. You should not have let hard castings like that come into the shop."

§ 77. Opposition to Premium System.

That there will be organized opposition on the part of the men to the introduction of a premium system is a foregone conclusion—there is usually opposition to any innovation regardless of its merits. In the case of the premium system there is perhaps a better foundation for prejudice, since rate changing on the part of short-sighted manufacturers—the bane of the premium system—has brought it into such general disrepute among employees that in many cases they will have none of it.

This undeserved opprobrium has prevented the introduction of the premium system into many plants where it could and should be used. Where the system is opposed in this, not unreasonable but unreasoning way, the same ideas and principles may frequently be introduced without serious opposition by giving the system a different designation, such as "Standard

Operation Plan," "Gain-Sharing System," "Merit System," or "Bonus System."

Where the opposition to the system is because of its novelty, it will disappear just as soon as the men realize that it will work to their advantage and that its adoption is in good faith; i. e., that it is not introduced for the purpose of "speeding up" production and then cutting down rates.

As a rule, employees are skeptical as to any personal benefits to them from the premium plan and their objections will not be overcome until they are thoroughly convinced that it will inure to their benefit. Then, and not until then will they work in harmony with the system and exert themselves to make all the additional wages they can.

If any serious opposition to the introduction of a premium system is anticipated, an excellent way of avoiding or overcoming it is to put a few trusted men in different parts of the factory at premium work and allow them to make fairly good gains. They will talk about their increased earnings and in all probability exaggerate them, until the envy of their fellow workmen is excited and the erstwhile opponents of the system begin to clamor for premium work for themselves. The method is one that rarely fails.

§ 78. Fixing Premium Allowance.

The fixing of time allowance, rates, and the subsequent operation of the premium system should be in charge of a practical man who is thoroughly competent to handle its details, and he should be assisted by a clerical force equal to about two per cent. of the total number of employees; one man being employed in the factory to take the time—if time is kept by timekeepers instead of clocks—and one in the office, for every one hundred employees.

The parts or production units and the operations to be brought under the premium system must be standard. The premium system therefore appeals more forcibly to a manu-

facturer whose output is a standard type of product as having more parts and operations susceptible of premium treatment. The best way to determine these parts and operations which are to be brought under premium allowances, is to hold a meeting of the foremen, consult the drawings, and decide what parts and operations shall be considered as standard, and what department or departments shall do the work.

After all standard operations have been determined and recorded, the next step is the setting and listing of premium allowances; i. e., the standard times allowed for their completion, or the required output for a certain specified time. When sufficient data as to the time required for the various operations is at hand, this is readily accomplished but when there is insufficient data on any particular operation an estimate must be made, or otherwise an average time be determined by making up a number of the parts involved in this particular operation. Estimates of a busy foreman as to how long it ought to take to perform such an operation, must be necessarily inaccurate, and rates set by such estimates are practically guesses. Estimates of this kind are only useful as establishing a tentative time standard, subject to correction as tests are made for the purpose.

If the times of different operatives are taken to establish an average on a certain operation, then ordinarily 10% of this average should be deducted to arrive at the proper premium time. Thus, if the actual average time for a certain operation is five hours, 10% of this time must be deducted, leaving four and one-half hours as the established premium time for that operation. This will in fact be a very liberal premium allowance for the workman. It will be found, as a rule, that the work will be done in less time than this average and the decrease in time may run as high as 25% and over. In some cases it has been found that operatives cut such time allowances by as much as 50%.

Time once set should not be changed short of a year, un-

less some time-saving device is introduced, or time saving conditions arise which give obvious and undoubted cause for change of the premium allowance.

In practice it is sometimes possible to determine the proper time for a certain operation or the proper output for a certain specified time by setting two men of fairly equal capacity on the same kind of work in direct competition. Each will naturally try to beat his fellow. In the course of a comparatively short time their respective merits are determined, and as soon as it is definitely settled which is the better man, they both stop trying. Before this point is reached, however, it is possible to determine how fast they have been working and to set the pace for efficiency effort.

In fixing premium times and rates under what is known as the Taylor system, there are two fundamental assumptions to be considered,—(1) the man can do his "theoretical best" if properly instructed and coached, but not otherwise; (2) a man will do his "theoretical best" if adequately remunerated, but not otherwise.

The successful application of these principles depends upon the following conditions of practice:

(1) A large daily task that must not be impossible.
(2) Conditions so standard that work may be accomplished with certainty.
(3) High pay for success.
(4) Loss in case of failure.

The first of these conditions is based upon the well-known fact that if you give an employee a specific task to do in a predetermined space of time, he will do it more efficiently and more rapidly than if he is given the same task to do in an indeterminate time. That this principle has not been more generally applied is due to the failure to appreciate how easily the application may be made.

The second condition is obviously necessary. If the workman is delayed by causes beyond his control, he fails in

meeting efficiency requirements but the failure is not his fault. Under such circumstances he cannot fairly be penalized; it is entirely uncertain whether he is entitled to any premium, and the only equitable thing to be done is to pay him the standard rate for full average efficiency. This is, however, unsatisfactory and it is far better to prevent such contingencies by providing against delays or idle time as far as possible.

The third and fourth requirements are obviously necessary to the successful working of the premium plan. If the premium payment is not sufficiently high the men will not maintain the high standard of efficiency effort necessary to its attainment, and the whole premium system will prove a failure. A penalty for failure is also necessary, for otherwise on jobs where the time allowance is close the workmen will not endeavor to gain a premium, with a resulting loss to both them and their employer. Where, however, workmen are charged with losses and only paid their net gains, they will under any fair system work as fast as possible at all times so as to gain where the gains are adequate, and, where the gain is doubtful, to prevent the loss of any part of that already gained.*

§ 79. The Premium Rate.

In some few plants where the premium plan obtains, workmen are paid full rate for all time gained on premium work. In most plants, however, they are allowed one-half the total time gain. The latter seems to be the better method. Under this method, if a workman's time allowance on a job is 12 hours, and he does the work in 10 hours, he has gained 2 hours, half of which is his at the regular rate. If his rate is 25c per hour and a day's work 10 hours, he is, under the premium system making $2.75 per day where otherwise he was making but $2.50 per day. On the other hand, the arrangement is even more beneficial to the employer, who is

* As to the premium allowance required to secure the best effort, see § 21.

securing work at a labor cost of 25c. which under normal conditions would have cost him 50c., and at the same time has saved his manufacturing expenses for two hours.

An increase of 10%, as in the instance just given, is but a fraction of what the workmen actually gain under a fair premium system. In practice it will be found that a good workman will average an increase of about 25% over his ordinary wages.

§ 80. Stability of Premium Rate and Allowance.

In establishing the premium system care must be taken that the standards are fair, attainable, and reasonably stable. Standards too high will discourage the workmen. Standards too low will result in excessive payments. Frequent changes of standard will discredit the whole system.

The importance of stable premium allowances cannot be overestimated. Nothing will cause dissatisfaction more quickly and with greater justice than an increase of standard after the premium system has been adopted. A fairly safe rule is to fix a standard time which will insure to the average employee under average conditions and with average effort, the ordinary wages which he could earn under the ordinary day rates. On this basis and with a premium of 50% of all time saved, intelligent application on the part of a fairly good employee should enable him to attain from 25% to 40% in excess of the regular rate.

After the workmen have become skilled, their earnings will increase greatly and will often be out of all proportion to their increase of exertion. This is particularly true if the time standard has not been intelligently fixed. Thus under the 50% plan of gain-sharing an operator sometimes reaches a point of skilled rapidity at which he can do in four hours work that he formerly required ten hours to accomplish. In such case he receives one-half of the six hours' saving, or three hours' extra pay, which is a 75% increase in wages.

This seems inordinately high, but unless it is manifestly excessive the employer had better let his time allowance stand. The gain is not to the employee alone, for the employer is likewise receiving materially increased returns without any corresponding increase of cost.

If the employer does yield to the temptation to cut prices, as is often done, to about the same average as before, he is in effect penalizing his men for responding to the anticipated stimulus of the system he has himself introduced, and he has no ground for complaint if his workmen in turn seize the first opportunity of "penalizing" him.

Certainly the workman cannot be criticized, when standards and rates are continually cut so as to prevent increased effort from receiving correspondingly increased compensation, if he loses interest in his work and devotes his "efficiency efforts" to the building up of his union rather than to the building up of his employer's business. In the union the superior workman seldom gets all he is worth and it is not difficult to enlist him under the factory banner if he is convinced that his efforts will be honestly and adequately rewarded. He must, however, be reasonably sure of his reward.

The effect of cutting rates is well described by Mr. Taylor in the following paragraph:

"It is, however, under piece work that the art of systematic soldiering is thoroughly developed. After a workman has had the price per piece of the work he is doing lowered two or three times as a result of his having worked harder and increased his output, he is likely to entirely lose sight of his employer's side of the case and become imbued with a grim determination to have no more cuts if soldiering can prevent it. Unfortunately for the character of the workman, soldiering involves a deliberate attempt to mislead and deceive his employer, and thus upright and straightforward workmen are compelled to become more or less hypocritical. The employer is soon looked upon as an antagonist, if not an enemy,

and the mutual confidence which should exist between a leader and his men, the enthusiasm, the feeling that they are all working for the same end and will share in the results, is entirely lacking."*

It has become an axiom in the commercial world that in the long run those transactions most promote prosperity which are advantageous alike to buyer and seller. It is becoming to be realized in the industrial world that the same axiom holds good regarding employers and employees, and that no arrangement can be permanently satisfactory which is not beneficial to both.

The employer who insists on more service than he pays for, and the employee who demands excessive wages for his work, both lose in the long run. The former is worried continually by dissatisfied workmen on the verge of a strike, and the latter lives in constant dread of being superseded. The ideal condition is efficient work with high wages. With proper management it is an ideal entirely possible of attainment.

§ 81. Introduction of Premium System.

Fixing the premium allowance and rates is, of course, preliminary to the actual introduction of the premium system. The methods of beginning operations under the system will vary with the character of work and the class of workmen. In some cases but little more is necessary than to call the workmen together, explain the matter fully, show them that a liberal time has been set on all operations—sufficiently liberal to be reduced materially by all who try—and finally assure them that the time will not be cut on the work unless justified by the introduction of labor-saving machinery or some other change of conditions similar in results.

It should also be explained very clearly to the workmen that if they do not reach the fixed standard, which is, as already explained to them, easily obtainable, the loss, unless

* Taylor, "Shop Management," pp. 1351, 1352.

due to causes beyond their control, will be charged back to them and that they will only be paid their net gain.

It is taken for granted that a cost system exists in the factory where the premium system is to be installed and that many of the forms prerequisite to a premium system—which are incident to any good cost system—are already in use. It will not be necessary, then, to familiarize the workmen with new forms but merely with minor changes which the more intelligent class of employees will readily understand.

The foremen will, of course, be instructed fully in all new details involved in the introduction of the plan, and until the system is installed and in successful operation their supervision will have to be much closer than ordinary.

It will frequently be necessary to give operatives training in speed, for in many cases it will be found that even with liberal time allowances the employees cannot perform the operation within the specified limit. Thus, it may be determined that a certain operation can be performed in an hour and the best record among the employees for this same operation be an hour and a quarter. Under such circumstances the employees are usually very confident that this time cannot be reduced. Then, if the time allowance has been justly fixed, a teacher must be employed who will determine the best method of working and devote time and patient effort to speed training until all those who are capable of average speed can attain the standard. Even after this, employees frequently require careful supervision to prevent their dropping back in the old, inefficient ways.

As illustrating the difficulties sometimes encountered in the introduction of a premium system, and the method by which these difficulties are overcome, the following account by Mr. Gantt will be found of interest.* It relates to the introduction of a premium system in a cotton mill in which a cost system had been previously installed. Some little work had been done towards the introduction of the premium sys-

* "Work, Wages and Profits," pp. 144-147.

tem and, as stated by Mr. Gantt, the little already done "was so beneficial that in April, 1908, the treasurer asked me to come and finish up the job, saying that he now had a new superintendent who was in sympathy with the work, and that the worst foremen were gone. * * *

"Twelve new looms had recently been installed in the weave room, and as soon as a competent man could be got, we began to study how to run these looms most efficiently. A pick counter was put on each loom, and the best weaver in the room (a Pole named Samtak) was given four of them to run.

"A trained observer with a stop watch stood by the weaver and studied all his motions in detail. He learned how this skilful weaver stopped and started his loom, how he removed the empty bobbin from the shuttle and put a new one in, how he tied the knot. From these observations he found out how much time it was necessary for the loom to be stopped in a day, and consequently what proportion of the time it should be actually weaving. No time was allowed for 'loom out of order,' or 'no filling,' or any other cause that might be eliminated. Steps were taken to be sure that the loom was in good order and that the proper filling should always be on hand, and a task was set on the supposition that all removable obstacles would be removed. This task was fixed as the number of picks the loom should throw, provided these unnecessary delays were eliminated, and a substantial bonus was offered for its accomplishment. It was expressed as a percentage of the total number of picks the loom would throw if it ran constantly all day without any stop. It is interesting to note that the task was greater than the best weaver had been able to accomplish regularly before we had made special provision to remove the obstacles. Having decided upon the task, three of the next best weavers in the room were chosen to do it, and Samtak was the instructor to teach them how.

" * * * The first man, Papadimitri, declined to work

under instructions and on task work. He was not discharged, but allowed to work in his own way until he should see where his interest lay. We, therefore, had Samtak give all of his attention to the other two, our observer, who had studied Samtak's work, being constantly on hand keeping a record of the number of picks each loom threw per hour, and removing the obstacles to the men's performing the task. Both men failed to earn a bonus on the first day but on the next two days they came so near it that it was allowed them, and they got a credit."

At this point the observer concluded that the men's failure was due to defective conditions both as to mechanisms and material supply. He therefore devoted his attention to the correction of these conditions, and almost two weeks elapsed before the men were again started on premium work. By this time the recalcitrant workman Papadimitri had concluded that the "game was worth the candle" and wanted to start too. All the men began to make their bonuses quite regularly.

"It was necessary, however, for our observer to be constantly on hand and to keep a record of their work, hour by hour, for he would frequently find some loom falling behind, which, if not looked after, would cause the weaver to lose his bonus. Whenever he found a loom not doing all it should he called Samtak's attention to it, with the result that the cause was soon discovered and removed; but Samtak seldom at first noticed a lagging loom. Again, Samtak was at first very slow at making any complaint if anything was wrong, but the example of our instructor and the incentive of a bonus of 6 cents for each weaver who made his bonus, and 10 cents each if *all* made bonus, gradually taught him to look out for their interests and his own."

As a final result the premium system was firmly established in this mill to the advantage of both employers and employees. As his conclusion from the experiment, Mr. Gantt says: "We note the following: That the amount of su-

pervision needed has diminished; that the quality of the work is better; that the quantity is greater; that the amount being turned out can be predicted accurately, and hence promises need no longer be guesses, but can be made and kept; that the workers are not only earning more money, but are acquiring better habits of work which will make them better citizens."*

§ 82. Payment and Adjustment of Premium Wages.

When the premium system is in force the operations of employees and their premium time allowances are entered on the premium card in the same manner as they are entered on the shop order tag. (See §§ 33, 34.) Such a card relieves the cost-keepers from the necessity of writing in the operation at the time production reports are received, and is also a means of separating any operations on which no premium is to be figured. The system of entering and checking should be so complete and thorough that there is no possibility of missing or miscalculating a workman's premium gain. This is something that should be guarded against with the greatest care. Shortages in premium pay, no matter how small, will cause an entirely disproportionate discord and dissatisfaction among the workmen and must be avoided if satisfactory results are to be secured.

Premium wages are usually paid at some certain fixed time, as semi-monthly, monthly, or bi-monthly. When the pay period comes round the workman's weekly gain sheets are added, and he is paid one-half his total gain for the period, the other half being held back against possible premium losses.

In the event of a workman making a loss instead of a gain in his premium work, a slip showing the details of this loss is made out and forwarded through the superintendent to the foreman of the department in which the loss was made, who should be required to make an explanation of the occurrence. If in his opinion, the premium time is not too low,

* "Work, Wages and Profits," p. 159.

the mistake should be remedied and the workman given the benefit of the corrected time. If, however, the time is ample and the workman is responsible for the loss, then the lost time should be charged against his previous gains for the month.

In case work is spoiled or bad castings are discovered, they are immediately replaced on the foreman's order, a form similar to that of Figure 148 being employed for the purpose. A report on a form such as that shown in Figure 149 is also filled out in order that a proper record may be had of the matter, both from the physical and financial standpoints. If the workman is at fault he gets no time allowance for his spoiled work.

It sometimes happens that a job comes to a workman in bad condition, requiring more or less work on his part to bring it to the point or state in which it should have reached him. In such case the lost time of the second workman is charged against the workman from whom the defective work was received.

CHAPTER X.

APPLYING LABOR COSTS.

§ 83. Methods of Applying Labor Costs.

Applying labor costs to the product into which it enters is a comparatively simple matter. Six general plans or methods—described in the following sections—are in fairly common use.

Ordinarily but one of these plans of applying labor costs is used in any one factory. Occasionally, however, one plan will be found in operation in one or more departments of a factory, and a different plan in other departments of the same factory. Also different plans of distributing labor costs are occasionally used side by side in the same department of a factory where the nature of the work or the conditions make this possible and desirable. The use of more than one plan in a single establishment is not in any way objectionable, unless the duplication of forms and methods produces too great complexity.

§ 84. (1) Order Number Estimate.

Under this plan of applying labor costs, the cost of a given shop order is estimated, this estimate being based upon periodical tests or otherwise upon the length of time various operations ought to take, and the labor cost is applied to the specific order number.

The plan is not to be recommended. Periodical tests do not afford a reliable basis for the application of costs of any kind and should not be used save under exceptional circumstances. Nor does the length of time the operations ought

to take afford a safer basis for calculating costs. Conditions change and the time an operation ought to take, even though correct when determined, may in course of time come to be absolutely false.

§ 85. (2) Specific Order Number Charges.

When this plan of applying labor costs is employed the exact production time of each employee expended on a specific order number is charged to that order number at the regular pay-roll time rate. Where the method is applicable it is accurate and satisfactory.

§ 86. (3) Piece-Work Plan.

Under this method of applying labor costs the specific order number is charged with the piece-work rate, job price, or the premium rate and earnings for all work performed upon it by individual laborers. The method, where it can be used, is accurate and satisfactory.

§ 87. (4) Averaged-Hour Plan. (Sold-Hour Plan.)

Under this method of applying costs, labor and expense are merged and the total number of hours directly applied to a specific order number in each department is charged to that order number. The rate per hour for this charge is based on the average net labor and expense cost to the manufacturer of all direct producing time in that department for a given period.

This is a method of averages. The number of hours of labor consumed by a specific order number is charged to it at the averaged cost of labor (with expense included) and not at the actual pay-roll cost. Under certain conditions the plan is reasonably accurate in results and is more easy of application than the specific order number charge.

The general method of cost finding, known as the "Sold-Hour" method, in which the "averaged hour" is employed, is discussed in Chapter XX.

§ 88. (5) List-Percentage Plan.

Under the list-percentage plan of applying labor costs, the labor cost of the goods produced is derived as nearly as possible from the records of previous periods, and, expressed as a percentage of the list price of such goods, is charged to the entire mass of product in each department for a given period, or to individual order numbers when preferable. Any variations between the actual costs and these list-percentage costs are subsequently determined and recorded. The method is used in connection with the list-percentage plan of cost finding discussed in Chapter XXI of the present volume.

§ 89. (6) Machine-Hour Plan.

The machine-hour plan is not only a method of applying labor costs, but is a complete method of cost finding, applicable to certain industries, and, when properly applied and used, the most accurate of the various systems of cost finding. Under this method, labor and expense costs are both charged "through the machine," or in some cases through groups of machines called "industrial centers."

For each machine or industrial center, as the case may be, an hourly rate is determined—based on the labor and expense charges incident to the operation of that machine or industrial center—and this hourly rate is charged to the product for the time it has monopolized the services of such machine or industrial center. The labor and expense cost of goods thus determined is passed to the credit of the producing machine, any variation between the operating cost and the earnings of these machines for successive periods being properly adjusted.

The general method of cost finding known as the Machine-Hour Plan, is treated at length in Chapters XXII to XXVII.

§ 90. Special Distribution of Labor Costs.

When a workman takes lumber or other material and cuts out of it parts of possibly four or five units of product,

with resulting scrap from which parts for other products can be evolved, the proper distribution of labor costs and the material costs likewise is a problem. Where such conditions exist the point method may be used to advantage.

Under this method a shop order is used covering whatever pieces the cutter is likely to get out of his material in a specified time. A week is a convenient period, the week-end ordinarily presenting a good cleaning-up time. For the first two or three days after the plan is instituted the cutter keeps "tab" on the average length of time devoted to each part of his product, and a record of this time is made by "points" so as to establish a comparative scale whereby the labor costs may be equitably distributed.

The time required to produce the largest piece of product or the one consuming the greatest amount of labor is set at ten points. The next piece by comparison of average time consumed, may perhaps be properly fixed in the scale at eight points, and so on down the line to the piece consuming the smallest amount of labor.

A count is necessary in order to ascertain the total product for the period. This may be an actual physical count, or the product may be ascertained by measurement in the case of wood, or by weight in the case of metal.

Assuming that we have under consideration wood parts, and that the week's product includes 56 parts of ten-point product, with a total of 560 points; 183 parts of eight-point product, with a total of 1,464 points; 79 parts of seven points, totaling 552 points; and 127 parts of two points, aggregating 254 points; we have a grand total for the week of 2,831 points.

The labor cost having been, say, $18 for the week of fifty-four hours, the value of one point is easily ascertained to be $.0064, and the time consumed per point to be 1.144 minutes; the former to be used as a basis of labor costs by extending the points on each part to secure the labor cost of

such part; the latter to be used as the basis of expense burden under any of the plans of expense distribution which use labor time as a basis of diffusion.

The material can be apportioned in like manner either on a basis of "size" points, or by the exact measurement of each part plus a percentage loading to cover waste on actual results, this percentage being obtained by tests each month.

If stock is removed before the end of the week when this method of costing is practiced, it should be removed by known quantities so that the record may not be lost. In the case of parts made of wood, sheet or bar iron, or steel, this can be accomplished by trucks with sides marked or scaled in such manner as to indicate quantities by the height reached on this scale.

The point system is applicable wherever a number of parts are cut out or otherwise treated at the same time, as also in any operation where several parts which cannot be kept separate are worked on by one workman, or again where the workman cuts material into any one of a dozen different patterns according as the material may cut to advantage. Under any of these circumstances the point system not only gives a good basis for the application of costs but also serves admirably to check up on the work of the cutter. It gives a positive record of the goods produced from a given amount of raw material, and establishes comparative figures by which the efficiency of the workman may be readily judged.

PART IV.—EXPENSE.

CHAPTER XI.

THE EXPENSE BURDEN.

§ 91. Importance of Proper Distribution of Expense Burden.

Expense is an inevitable incident of production, but a most elusive incident, almost impossible of proper determination and distribution unless the plan of accounting be intelligently devised and as intelligently and faithfully carried out.

Of the three elements of production cost, expense is unquestionably the most difficult to accurately determine, and even when this is done the end in view is but half attained. The expense as determined is still to be applied to the manufactured product so that it will in connection with the charges for labor and material disclose the true cost of production.

The important part that expense plays in production cost and the necessity for its proper distribution is not always recognized. The cost of labor and material stand out clearly. Usually such costs are closely coupled with specific order numbers, or with the mass product in process, or with departmental costs, and are brought into further prominence by clearly defined payments at fixed times. The burden of expense, on the other hand, made up from many varying sources, not clearly seen, indirect in its application, and scattered as to time of payment, is very much more difficult of determination and does not seem so worthy of consideration. Yet the weight of the expense burden is in many cases the factor that decides the success or failure of an enterprise.

"These shop charges frequently amount to 100 per cent., 125 per cent., and even much more of the direct wages. It is therefore often actually more important that they should be correct than that the actual wages cost should be correct. If we have to put a dime and also a quarter in a certain collecting bag, it is certainly more important that the quarter should not go astray than that the dime should be looked after."*

§ 92. Production Costs and Selling Costs.

In determining the expense items properly applicable as factory costs, a sharp line must, of course, be drawn between the two broad classes of expense—manufacturing expense, and commercial or selling expense. Items which pertain purely and simply to the sale of product have no place in the cost of production. This is also true of those other commercial expenses which have to do more or less directly with the delivery of the product and with collections, such as cash and quantity discounts, crating, hauling, freight on outgoing product, allowances after product has left the factory, etc., etc. Such expenses are a proper charge, direct or indirect, to loss and gain, but not through production, and any attempt to fasten them on production will be a purely arbitrary process, entirely without advantage and entirely destructive of accurate costs.

The writer recently visited a manufacturing concern which makes a flat price on delivered goods anywhere within the United States regardless of distance. The cost of transportation is thus a burden to be borne by the concern—a burden which was disposed of as an item of production cost. The uncertain, varying, useless, and almost meaningless production costs which resulted can be imagined. Goods identical in every respect might have as many differing production costs as there are shipping points with differing freight rates in the United States. Any of the other costs involved in placing the goods in the consumer's hands, such as advertising, salesmen's

* Church, "Proper Distribution of Expense Burden," p. 40.

expenses, etc., might with equal propriety be charged to the cost of production. Production costs are supposed to stop when goods are ready for delivery, and the inclusion of any charge beyond this point introduces an element which does not belong there, and which effectually removes any possibility of accuracy in the cost records.

With a proper segregation of commercial costs and of production costs, and a full knowledge of these latter, a just and proper selling price can readily be determined. Also the proper and economical conduct of the production and the selling departments is greatly facilitated. This cannot be done where the two classes of expense are not clearly separated.

§ 93. Uniformity in Costing.

A general uniformity of practice as between different establishments in respect to expense charges to production costs is very desirable. Thus some concerns charge into manufacturing expense the item of interest on investment. Others do not. Some concerns charge supplies directly to manufacturing expense without first putting them through the storeroom, even though a large supply is purchased for future use. Others, more properly, charge such supplies to manufacturing expense only as they are actually used. Similar variations of practice in charging expense costs run through the entire production process.

As one of the consequences of this lack of uniformity, concerns manufacturing similar lines of product cannot compare costs of production intelligently, and in fact fail dismally when they attempt to do so, because their respective costing charges are not on the same basis. Under such circumstances it is obvious that the production cost of similar goods in these different factories must necessarily vary materially—a condition which leads to puzzling and unwarranted variations in quotations, sometimes very perplexing to com-

petitors, and occasionally very disastrous to the "quoting" concern.

§ 94. Analysis of Manufacturing Expense.

Expense items for term charges as they accrue should be analyzed from invoices or original entries on to an analysis sheet suited to the needs of the particular business. (See Figures 136-141.) In this analysis will be included items which are direct charges to departments and also items which are partially or wholly applicable to administrative or commercial costs. After all the items for the month or cost period have been thus analyzed or classified under their proper headings, that portion of them which is directly applicable to production costs is ready for distribution among the producing departments. An equitable division between departments is necessary if any degree of accuracy is to be attained in the determination of costs. (See Ch. XVII).

§ 95. Suspense Items.

At times comparatively heavy expenses are incurred applicable to costs, which have not been foreseen and which cannot properly be regarded as capital expenditure, and yet which cannot with equity be charged against the expenses of a given cost period. To this class of expenditures belong insurance items paid in advance, interest charges paid before such interest actually accrues, the installation expenses of a cost system and other professional services the benefit from which extends over subsequent periods. Office stationery and supplies are frequently put in this same category.

In any such case the item may be charged to the proper account in the "Suspense" section of the Private Ledger. From the reserve thus established a monthly or periodical apportionment is made by crediting the particular suspense account and charging the proper expense account. The monthly amount to be charged from the suspense account rests in the

judgment of the management or of the accountant in charge and will under some conditions vary for the different months according to the proportionate benefit received. The whole matter is one that should be governed strictly by the facts; i. e., the reservation must be justified and the succeeding periods must be actually benefited by the expenditure to the same degree as is the current period, or in proportion to the amount charged to such periods.

In Figure 1 (H) the suspense account group is shown as a negative asset, indicating that these reserves have no debt-paying qualifications. Such accounts should be kept distinctly separate and apart from other accounts which represent assets, in order to avoid misleading impressions.

§ 96. Reserves for Expense.

On the opposite side of the balance sheet shown in Figure 1, under Negative Liabilities (K) is shown a group of actual reserves. These differ from the suspense accounts of the preceding section inasmuch as the expenses they cover are anticipated. They represent amounts set aside and built up from month to month for some specific purpose or to meet demands accruing as time proceeds and as yet not due and payable. Such demands may perhaps be of an intangible nature as, for instance, where the actual liability is being incurred but where the amount of such liability cannot be positively measured, weighed, or counted until some future period. In this class are:

(1) Taxes.
(2) Interest.
(3) Experimental Costs.
(4) Over, Short and Damage.
(5) Variation of Weights and Measures.
(6) Factor of Safety.
(7) Maintenance.
(8) Depreciation.

Reservations of this kind are made as the occasion arises and such monthly or periodical amounts are credited to them and charged into costs as may in the judgment of the management seem necessary. If justly determined they will provide an adequate reserve against which costs of the nature mentioned may properly be charged as they become payable.

The amount of the monthly or periodical credit for such reservations may or may not be sufficient to ultimately absorb all of the anticipated costs. If the credit actually made proves to be insufficient, the account "Factor of Safety" may be called upon to absorb the difference.

The Factor of Safety Account, as its name indicates, is a general reservation to cover unforeseen contingencies. The account should not be used to establish a secret reserve with which balance sheet figures may be manipulated, but should be honestly confined to such amount as is conservatively estimated will cover the probable demands upon it. This is, of course, purely a matter of estimate, and if at the close of a fiscal period the balance of the Factor of Safety Account is found to be unreasonably large, a portion or all of the balance may be absorbed into the profit and loss statement.

§ 97. Distributing Expense.

Various methods of distributing expense are in use, differing in principle, and involving distinctly different processes in execution. They have been largely devised by men who are engaged or interested in certain lines of manufacture, and who have evolved methods suited to the conditions in their own plants, or in plants of a similar nature. Under such circumstances, it is a natural result that there are now various methods of expense diffusion recognized as standard, each of which is suited to certain conditions, and is entirely inapplicable when these conditions do not exist.

In selecting a system for any particular factory, the accountant will, of course, be governed by the conditions pre-

vailing in that factory and select the method of expense distribution best fitted to meet its requirements. It may on occasion be found necessary to use different methods in different departments of the same factory; the method applicable to the product in one state of process not being applicable to the product in another state of process, or the product of one department varying in its character from that of another department.

§ 98. Methods of Distributing Expense.

There are five methods in general use for the distribution of expense: the "Labor-Percentage Plan," "Man-Hour Plan," "Sold-Hour Plan," "List-Percentage Plan" and "Machine-Hour Plan." These different methods of expense diffusion are treated in detail in Chapter XVIII of the present volume.

CHAPTER XII.

PLANT INVESTMENT AND RENT CHARGES.

§ 99. Interest on Investment.

There has been and is even now some difference of opinion among accountants and engineers as to whether interest on investment in plant and producing factors is a proper production cost. In the long run—i. e., when loss and gain is reached—there is, of course, no difference in accounting results whether interest on investment is charged into production costs or not, provided the selling price of the product is the same in either case. If interest is not charged to production, the costs are apparently less than is otherwise the case, but this is offset by the larger debits elsewhere, and the net profit is the same as before.

The difference of opinion as to whether interest on investment shall be reckoned in costs, results from different views as to the status of capital owned by the principal. Those who advocate the exclusion of interest on investment apparently regard capital owned as of a nature entirely separate and distinct from capital borrowed and as not entitled to consideration in estimating costs. The differing views of accountants as to the proper treatment of interest on investment in production factors are briefly presented in the sections which follow.

§ 100. Exclusion of Interest on Investment. An English View.

"No charge should be made in Cost Accounts for the services of a principal, nor for interest on his *own* capital.

Whatever return is produced by these is profit, and not an expense of manufacture.

"As regards interest on *borrowed* money, some difference of opinion prevails as to whether it should be provided for in Oncost. It is no doubt an expense of the business, but it is a matter of finance rather than of manufacture, and, as such, should probably, like discounts, be kept out of the Cost Accounts. The point is not very material so long as the manufacturer knows whether his gross cost does or does not cover interest."*

It may be said in partial explanation of this statement that the English principal as a rule does not take the very active part in factory management customary in this country. His function is more purely financial and for this reason English views of both the principal's services and interest on his investment are somewhat different from those prevailing in this country. This fact, however, hardly justifies the very sweeping exclusion of both services and interest from manufacturing expense. Nothing belonging to the principal must be brought into production costs. If, then, the principal were "strong-handed" enough in his own family to run his wood-working factory without employing outside labor; if he cut his raw material and fuel from woodland owned by him, and if this material were turned into manufactured products by his own machinery, his production costs—save as to a small modicum of overhead expense—would be nothing.

The whole conception is wrong. Anything of value going into production should be counted in the cost of production no matter to whom it belongs. A paper mill may own its own woodland, but, nevertheless, pulp at a fair value is charged into production cost of paper. Iron works may own ore beds, reduction furnaces, etc., but the value of the material, depreciation of furnaces, etc., goes into production costs just the same, and the mere fact that capital is owned by the principal is no reason for treating it differently

* Hawkins, "Cost Accounts," p. 109.

from any other values employed in the business. Similarly as to the principal's services: if they are worth nothing, nothing should be charged for them, but if they are of value they should be represented by proper charges in the business just as are the services of other employees.

§ 101. Inclusion of Interest on Investment. An English View.

"The question of interest on plant as an item in the cost estimate is one on which varying opinions are held, mostly theoretical. * * * The custom generally, however, is to look for the return on the capital expended under this head (equipment) in the increased balance of profit from the factory, and to omit any provision for the interest charges under this head. * * *

"In the case of some continental factories the accounts are debited with the interest on the capital employed therein; and if we are to admit that where the factory freehold is held by the firm operating, a rent-charge should be created, the same argument applies with even greater force to the charge on the plant.

"We may even carry this a stage further, and also charge to the factory, interest on the stocks of raw material on the same basis, for whatever advantage accrues to the factory from the employment of extra capital the cost of same should appear as a charge against its efficiency.

"It may appear that this is carrying the matter to a fine point, but if we consider that if the factory is held responsible for the interest provision on extra capital employed therein, whether it be in factory equipment or in holding of stock, or of the advantageous purchase of material on special terms, we are enabled to judge by the results in such case, whereas the effect in the enhancement of profit is, or may be, swallowed up by the operations of the Sales or Trading Departments."*

* Stanley Garry, "Multiple Cost Accounts," pp. 45-47.

§ 102. **Interest on Investment as a Division of Profits.**

In this country, while the weight of professional opinion is perhaps in favor of including interest on investment in production cost, some prominent accountants hold the contrary view. In the following extract from an address delivered before the American Economic Association, December, 1910, Arthur Lowes Dickinson*—who may be considered as expressing an American view—argues for its exclusion and for the exclusion of rent charges as well.

"Accountants frequently have to give opinions as to the propriety of including rent and interest in costs. In theory these two items are identical, rent being the sum paid to a capitalist for the use of land or buildings, and interest being his compensation for placing his natural product or his accumulated savings at the disposal of the manufacturer. Both items are therefore in the nature of a division of profits, out of which alone they can be met, and they should therefore be strictly excluded from costs. * * * This principle is recognized in the form in which railroad accounts are now prepared, where both rentals of leased lines and interest on borrowed money of all kinds are treated as a charge against the income from operations after the same has been ascertained, that is, as a distribution of profits.

"In the case of manufacturing companies no such clear recognition of this principle is found, and rent for factories, etc., where paid, is always treated as an item of manufacturing cost or expense, while interest, an exactly similar item, is more usually treated as a charge against or division of profits. This method of charging rent as an expense has led to a claim that it is properly so treated, and that therefore when a manufacturer owns his premises and pays no rent an estimated amount corresponding to the value of the use should be charged into and considered as part of the cost thereof. This sounds plausible but it is believed that a nearer approach to theoretical accuracy is to be found in the railroad practice of

* Bulletin American Economic Association, pp. 119, 120.

considering all rentals, at least when there is a natural division between rent and other service, as a charge against or division of profits.

"If two manufacturers have identical facilities for manufacturing the same article and adopt the same methods and at the same expense, it is certainly not reasonable to say that the manufacturing cost of the one who rents his facilities instead of owning them is higher than that of the other who owns them; but it is reasonable and correct to say that the former, who has a smaller personal investment, is sharing his profits with the capitalist who contributes the facilities.

"Similarly, in the case of interest, the manner in which capital is provided cannot affect cost of manufacture. A manufacturer may provide all his own capital or he may obtain some part of it from other capitalists who either take equal risks with himself or prefer in some way to limit their risk. The profit when ascertained has to be divided between the different capitalists according to the terms agreed upon, but no part of it should be an element of cost, nor should the method of its division be a factor in determining selling price."

From the standpoint of practical costing Mr. Dickinson's logic is not satisfactory. The interest on an investment in plant and equipment, or rent paid for use of factory would seem to be almost as direct an incident of cost as labor, material, power, or incoming freight. It is obvious that the manufacturer cannot make his product without a plant, and its rental or interest charge is usually one of the first incurred manufacturing expenses. Why, then, should it be differentiated from all other manufacturing expenses and be excluded from the cost of product?

§ 103. Inclusion of Interest on Investment. American View.

The following quotations indicate that the accountants who listened to Mr. Dickinson's paper were not all in accord with his treatment of rent and interest charges.

"In our cost of manufacture we usually consider interest on machinery employed in processes as a part of the cost of the product. This is necessary if we are to distribute costs properly between different articles of product and fix prices accordingly. * * *

"Mr. Dickinson and I, you see, are in perfect agreement as to what we want—namely, isolation of causes; but the line of cleavage between causes we are inclined to draw differently. Mr. Dickinson, conceiving profit to be a certain surplus divisible between all three of the agents of production—labor, land, and capital—wishes to exclude all interest from cost; while I, conceiving profit to be only what is left after rent, pure interest, and wages have been paid—that is, virtually the compensation for risks taken—wish pure interest, and pure interest only, to count as a cost. Many accountants count as cost all interest on investment, including all risk elements. * * *

"As Mr. Dickinson has well pointed out, if interest is allowed to count as a cost, it counts more largely when material is purchased partly or wholly manufactured than when only raw material is used. This does not seem to me objectionable. We are primarily seeking costs for the enterprise immediately concerned. If what is cost to it includes the profits for another enterprise, its costs will be (other things equal) inevitably greater. The accounts should show them so. We are, moreover, seeking also comparative costs; then, surely, we wish costs under conditions involving some one else's profits to show greater than under conditions where no profits are involved until the end. We wish causes isolated so far as possible. The plan that I suggest seems to me to provide such isolation."*

Or again,—"If I interpret Mr. Dickinson correctly, he does not believe that rent and interest should be considered as costs of production, but rather views them as deductions from profits. To the economist profit is a return over and

* William Morse Cole, Bulletin of American Economic Association, pp. 129-132.

above all rent and interest charges. If the owner of an enterprise does not secure that return, it would be better for him to lend his resources to some one else who would pay him the rent and interest and assume the risks of production. Moreover, if he should lend his land and capital, he can then work for some one else and get a wage, so that even the entrepreneur's salary or wage should be considered a part of costs, because he is entitled to pay himself as much as some one else would pay him. * * *

"To the speaker's mind all such charges are really direct additions to the cost of production and should be apportioned directly to the various departments involved. Rent and interest should not be regarded as divisions of profits, because profit does not start until provision is made for these items."*

It is very obvious that rent of factory buildings and interest on money invested in factory and for manufacturing purposes must appear in some way in the cost of conducting the business, whether they be regarded as production costs or as a division of profits. From the practical standpoint any cost necessarily incurred in the production of goods is most conveniently and most safely included in production costs.

§ 104. Reserves for Interest Charges.

Interest charges are usually made semi-annually or annually. To equalize the interest charges to production cost it is usual to establish reserves to which interest on investment is charged as it accrues and from which it is obsorbed by periodical charges against production costs.

If interest is charged as an expense and is not actually paid out, it must of necessity be credited to some reserve or representative account, and that account, whatever its title, will be a revenue account representing the earning of capital.

In the absence of such reserve accounts, if money or its equivalent is actually parted with or passed to the credit of an account payable, direct charges can be made to departmental costs on the same basis as in the case of reserves.

* J. C. Duncan, Bulletin of American Economic Association, pp. 146, 147.

Where reserves are made for interest charges, such reserves will have no direct bearing upon the net result of the Loss and Gain Account. Primarily they will lessen the margin of gross profit shown to exist between the production cost and the selling price of a given article, but this is offset by the credits or earning represented by the reserve account.

§ 105. Composition of Interest Reserves.

For the sake of simplicity, when reserves for interest charges are made, these reserves should include the interest on all capital invested. The proper distribution of the charges can be made later. The total reserves represent the earnings of the plant capital which presumably is invested by the owners of the plant. If, however, a part of this capital has been secured through sales of bonds or any other form of interest bearing loan, the interest charges on such bonds or loans are a proper charge against the revenue account, "Interest Earned." Such a charge will in nowise disturb the operation of sinking funds or analogous accounts where these exist.

Where the interest on manufacturing investment is charged as a part of production cost, the Loss and Gain Account will perhaps, as to the items given, show thus:

LOSS AND GAIN

Production Cost	$130,000.00	Sales	$170,000.00
Commercial Cost	20,000.00	Interest Earned	30,000.00
Net Gain	50,000.00		
	$200,000.00		$200,000.00

If the interest earned is not made a part of production cost, the same Loss and Gain Account will show thus:

LOSS AND GAIN

Production Cost	$100,000.00	Sales	$170,000.00
Commercial Cost	20,000.00		
Net Gain	50,000.00		
	$170,000.00		$170,000.00

Where interest on manufacturing investment is charged to cost, the amount of interest charges per unit will, of course, vary with the frequency of the turn over, the value of the product, and other direct influences.

§ 106. Inactive Investment.

Plant, tools, and equipment, like men, are earning nothing unless they are working. If, then, a portion of the plant is inactive or dormant for a period, it is manifestly unfair to burden the product of other departments with interest on the investment in inactive departments; nor are the accruing, unabsorbed costs of abnormally inactive times a proper charge against the cost of production during active times.

Under these conditions it is suggested that when interest on investment in dormant equipment is charged, it be charged directly to Loss and Gain Account and not be passed through manufacturing costs at all.

It is understood, of course, that this does not apply to equipment of such a nature that it is only used at long intervals. This is a normal use of such machinery, and it cannot be considered as dormant in the intervals between its use.

CHAPTER XIII.

LAND VALUES AND BUILDING SPACE COSTS.

§ 107. Land and Buildings as Factors of Expense.

As discussed in the preceding chapter, the expense incident to the occupancy of the land and buildings for manufacturing purposes enters into the cost of product as a distinct factor, and this is so whether the property is leased or owned. If the property is leased, the rent charges are usually a clean-cut proposition so far as production costs are concerned. If the property is owned in fee simple or held on some other basis superior to the ordinary lease, the costs involved are not so clearly seen but are there just as surely, and must be ascertained and properly applied if a true production cost is to be determined.

The expenses arising from the occupancy of land and buildings are charged to product through the buildings, but the methods of determining the expenses arising from each are different and require some separate consideration.

§ 108. Land.

When land is owned in fee simple and occupied for manufacturing purposes, the resulting charges to be applied to the manufactured product are interest on the investment, taxes, and other similar levies. These latter charges vary but little from year to year and may usually be estimated on the basis of preceding years. Should changes in the rate be made, the amounts involved may be properly distributed by adjusting entries, best perhaps through the Factor of Safety Account.

The principal cost item arising from the occupancy of land for manufacturing purposes when this land is owned, is

interest on the investment. As a rule this will be figured on the price paid for the land, the prevailing rate for money giving the rate for the interest charge.

§ 109. Increasing Land Values.

When land values change after manufacturing property is acquired, the basis of the interest charge depends somewhat upon the policy or the wishes of the management. If land increases in value after it is purchased, the increase is an incidental profit enjoyed by the general business but it is very questionable whether this tentative profit—which is not realized until the land is sold—should be reflected in increased costs on the goods manufactured on the land. As a matter of fact, there is no increased cost of production to the fortunate manufacturer. He enjoys, it is true, an advantage over competitors who acquired their land at a later period when prices were higher, but—save as to possibly increased taxes—he does not have to pay any more to produce his goods on this account, and, so long as the conditions are kept clearly in view, there seems to be no object in a nominal increase of his production costs because of an unrealized profit on his land.

§ 110. Decreasing Land Values.

The same principles are involved when land occupied by a factory decreases in value. The decrease involves a loss to the business which eventually must be absorbed in some way, but the owner has suffered no real loss until such time as he parts with the land for a less price than that which was originally paid; neither meanwhile do his goods cost any less to make—save as to possibly decreased taxes—because of the prospective loss on the factory. Under these circumstances it would seem proper to maintain the investment and the manufacturing costs arising from the investment in land at the original figures—unless and until the increase or deprecia-

tion in value of the land is brought on the books by proper entry.

§ 111. Land Values Varying as to Location.

Another condition bearing on production cost sometimes arises where extensions or additions to the factory buildings are erected on land, purchased for the purpose at a much higher price than was paid for the original property. Shall the increased interest cost this involves be charged to the goods produced in that portion of the factory occupying the high-priced land; shall it be distributed over the whole factory; or shall the excess price of the recently purchased property be charged off to loss and gain?

If any clear, distinct end is gained by charging the goods produced in the portion of the factory standing on the higher-priced ground, with the full interest on the investment in that particular land, it can and should, of course, be done. Usually, however, it is better to treat the land occupied by the factory as a whole, the increased or excessive price paid for the particular portion of it being merged through interest charges in the general costs. Or, if this excess cost is very great and entirely above the real value of the land, the excess price is best treated as an accidental involvement, to be charged off to loss and gain.

Speaking generally, when a portion of the factory property is purchased at a higher price than was paid for the balance, it would be manifestly absurd to load this excess cost on the goods produced on that particular land. It is reasonable to suppose that the purchase of this high-priced land adds directly to the value of the factory as a whole, and results in cheaper production costs than would have been secured if the new addition had been located on land of more reasonable price somewhere else. If this is so, the land cost is best treated as a lump sum, and the interest charges be diffused—through the buildings—on the basis of land space occupied, regardless of the location of this particular space.

§ 112. **Investment Interest and Mortgage Interest.**

In Mr. Church's very interesting discussion of the land factor,* a distinction is drawn between the investment as represented by actual cash put into a manufacturing property and that represented by a purchase money mortgage on this same property if the mortgage is drawing a higher rate of interest than that allowed on the cash investment. This is on the assumption that the mortgage is a purely financial arrangement rendered necessary or desirable because of insufficient capital, Mr. Church holding that the allowed rate should be estimated on the cost value of the entire property, and any interest in excess of this rate paid on the mortgage not be charged into costs but be disposed of in some other way.

The refinement is one of somewhat doubtful utility. If a mortgage is put on the property after it is purchased and as a means of raising money, the transaction is of a different nature. The factory property is then being used for other purposes than manufacturing, and interest charges arising in connection with this extraneous use have no necessary bearing on costs. When, however, a purchase money mortgage is given, it forms part of the transaction by which the property is acquired, and it would seem that its interest, even though above the prevailing rate, should in its entirety be charged to production costs.

It will be recognized that insufficiency of capital involves increased production costs in many directions. Thus, with insufficient capital the most advantageous arrangement of factory buildings and machinery is frequently impossible; machinery of highest efficiency cannot be procured because of its expense; power must perhaps be purchased when with proper equipment it might be produced more cheaply; materials cannot be bought in such quantities as to secure the lowest prices and the most favorable terms; production is not sufficiently large to attain the lowest production costs.

* "Production Factors," p. 72 *et seq.*

From the practical standpoint, the proposition to figure costs as less than they are, because existing conditions are faulty, will hardly meet with favor. Production costs that might be attained with ample capital are not the production costs attained when means are insufficient, and the manufacturer whose means are not sufficient wants to know what his costs really are and not what they might be under better conditions.

The manufacturer might, it is true, deliberately take a production cost for his product based on the highest possible efficiency under the most favorable conditions, and charge off to other expense accounts everything that would, if charged to product, raise his actual costs above these ideal figures. Such costs would, however, be of but little practical value, and it would seem to be better that costs should be based on the actual expenditures incident to productive work under the conditions which really exist.

§ 113. General Rule for Land Values.

As a general statement it may be said that the land investment for purposes of interest calculations should be figured on the value at which the land is carried on the books of the concern. Ordinarily this book value will be the cost value. If, however, those in charge wish to carry the land at the value at which it can be sold at that particular time, regardless of its cost price, the procedure, while not to be recommended from the accountant's standpoint, is entirely within their discretion. The interest on investment in land must then be calculated on this selling price of the land.

When land is purchased with a view to future needs of the business, the outlay is purely an investment and the interest on this investment is not in any way a factor of present production costs.

§ 114. Applying Land Charges.

These land charges are not applied direct in any sys-

tem of cost finding. Buildings are a necessary concomitant of manufacturing and the land charges pass through and are included in the building charges. Accordingly, when the matter of land value has been determined upon, the next step is to apportion to each of the various buildings or departments its proper proportion of this land value. Each building should be charged with as much ground as it is found to occupy, including a reasonable allowance for ingress and egress, light and air.

Land space occupied by stores, such as sheet iron and steel, oil tanks, chemicals, semi-finished product, etc., should be charged to stores department and in this way be eventually diffused over product. Space occupied by railroad tracks, yards, cranes, and transfer platforms, can be charged to local transport, and all other land directly used in connection with the factory can be classified and placed where it equitably belongs.

The land values apportioned to each building or department need not be entered in the ledger in the form of separate land accounts. On the contrary, the investment account representing the land in its entirety may be left intact and the details of apportionment be entered in memorandum form or in any other form convenient for reference. The value of land and the apportionment of this value, once fixed, remain unchanged for costing purposes until such time as changed physical conditions necessitate a readjustment.

§ 115. Building Costs.

In the case of land, as suggested, it is usually advisable to place a value on the property as a whole and from this derive one unit charge per square foot for all portions of the property. When we come to buildings the conditions are entirely different, inasmuch as these latter have individual characteristics, differing degrees of fitness, and different maintenance charges. For these reasons the floor space charges emphatically should not be averaged.

Some buildings, such as the power house, may be but one story high, while others nearby have five or six stories. Some buildings of defective construction may require expensive annual repairs. Others may have a small proportion of available floor space compared with the ground they occupy. Under these conditions the only method of arriving at an equitable cost charge for floor space is to let each building stand as an individual unit in the reckoning.

The first item in compiling the cost of the individual building is land space occupied. The value of this land space having been determined, the interest charge on this value is recorded on a cost calculation sheet similar to that shown in Figure 190. Next, the building itself must be appraised, either formally and accurately by a competent appraiser or approximately by the management. This value determined, the interest charges on the building itself are recorded on the cost calculation sheet.

§ 116. Maintenance and Depreciation Charges.

The annual charge for repairs and upkeep of buildings may be fairly approximated by an examination of the maintenance records for several representative years preceding. In like manner, the items of depreciation, taxes, and insurance are treated in succession, each item of cost as it is secured being properly recorded on the cost calculation sheet.

Repairs will not maintain buildings in their original condition. Even with the best of care, deterioration takes place and replacements are eventually necessary, though in many cases only after a long term of years. A sufficient amount must then be charged for depreciation to provide for the inevitable final replacement in part or in whole of the particular building or buildings; and the reserve for depreciation which should be established, is as direct an item of production cost as are repairs, rental, interest, power, or any other item of manufacturing expense.

Depreciation of factory buildings is a subject upon which volumes have been written and its treatment here must of necessity be brief.* In considering depreciation, classifications of the buildings on the basis of material are first considered. Buildings of wood, or partially of wood, naturally depreciate much more rapidly than do buildings of more durable material, and therefore require a much higher depreciation rate.

Buildings may be further divided into two general subclasses—those subject only to the ordinary deterioration from the lapse of time and the action of the elements, and those which are in addition affected by special deteriorating influences, such as constant jarring, abrasions, injurious fumes, etc., etc. In the first subclass are included warehouses, office buildings, pattern shops, assembling shops, etc., etc., while in the second subclass are included many of the buildings used for foundries, smith shops, heavy-duty machine shops, and lighter machine shops where high-speed shafting or machinery is attached to the walls or roof supports so that the effect on the buildings may be injurious.

§ 117. Depreciation Rate.

Under ordinary circumstances buildings of wood or iron should be depreciated from 4% to 10% per annum, the rate varying according to the design and solidity of the building, the climate, the regularity of painting, the general care given, and the purposes for which it is used.

Thus, strongly constructed wooden buildings in a dry climate might last almost as long as a brick structure, while light wooden sheds in a damp climate would not last one-sixth as long. Strongly built, well-fitted iron buildings will last as long as buildings constructed of bricks, if properly painted and cared for. On the other hand, the cheaper kind of iron building, on light columns with loosely fitted roof-framing and covered with corrugated iron, galvanized, but not paint-

* For full discussion of the subject see "The Depreciation of Factories," by Ewing Matheson.

ed, would in a damp climate be so wasted by rust and shaken by wind that it would require replacement in a comparatively short period, the old material being then almost worthless. In the case of stone work or reinforced concrete buildings, a depreciation rate of 1½% per annum will ordinarily suffice, if the roof-covering and the painting of iron and wood work are given proper attention. If such buildings are subject to strain resulting from continued concussion, a rate of perhaps 4% per annum will be required to properly cover depreciation.

§ 118. Applying Building Costs.

When the respective amounts of the items already discussed, together with any others peculiar to the particular building, have been determined, a total of all the items chargeable to that building can be drawn. This total will represent the annual cost of such building chargeable to product. This charge is made through departments and on the basis of the square feet of floor space occupied by each department.

To determine the rate of charge, when the total costs for individual buildings have been determined, the total for each building is divided by the number of square feet of available floor space in that building, which gives the cost rate for each square foot.

Just as the land was apportioned to the buildings on the basis of square feet or square yards properly allocated to each, so the floor space of the buildings is divided up as between departments. Stores, buildings, power house, office, warehouses, etc., will all come in for a charge on the basis of floor space occupied.

As land space is not usually all covered by buildings, neither is all enclosed floor space occupied by machines or even by distinct departments. Aisles must be preserved, and perhaps here and there some space must be left for temporary

storage of material or of semi-finished work between departments. All such space not immediately used by the particular department or machine must be equitably divided among the departments or machines which benefit from its existence or to which it properly belongs.

When the machine-hour plan of cost finding is to be used, the space occupied by each machine must be carefully measured, and charged to that machine at the determined rate per square foot. The same rule applies as to space not immediately used by a particular machine, but existing for the use of that machine. If space is left for the common use of several machines it is divided equitably among them.

In the case of individual or of group machines when these are considered as a unit, the space left for aisles, etc., can be included in the overhead burden. When an industrial center or a division is treated as the unit, the entire space occupied is included in one boundary, in which case aisles and open spaces are not separately considered.

The building cost charges, when determined, all have their places in the financial records. For this purpose a form similar to that of the cost calculation sheet (Figure 190) may be employed. One sheet will suffice for the entire year and from this sheet the entries can be made each recurring period. The various department expense accounts represented on the sheet are charged and the various revenue and reserve accounts are credited.

Where the machine-hour plan is used the several items of annual charges will appear on the record sheet of each individual machine. (See Figure 189.) Such items have already been automatically charged to the machine by the fact of their presence on the sheet as an annual item, and will be included in the machine rate of each individual machine. The entry, therefore, instead of being charged to departments, will be charged in a lump sum directly to the controlling account called "Machine Time," as follows:

Machine Time	$683.23	
Accruing Interest on Investment		$361.53
Reserve for Repairs		73.85
Reserve for Depreciation		117.70
Reserve for Taxes		99.23
Insurance in Suspense		30.92
	$683.23	$683.23

§ 119. **Leaseholds.**

When a manufacturing property is rented, the rental payment usually covers all the varying items of cost which must be determined separately when land is owned. Thus, when rent is paid there is no charge for interest on investment, or repairs, depreciation, taxes, insurance, etc., as far as these apply to the plant. The building costs are therefore much simpler of determination.

Distinctions might be drawn between the various buildings as to their condition, location, and general availability, but as a rule this is ignored and one rate is charged per square foot of building space. This rate is determined by dividing the total yearly rental by the total floor space of buildings expressed in square feet.

Where factory buildings are erected by the manufacturer, but the land upon which they stand is held on a ground rent, a combination of the methods pursued respectively when the property is owned in fee simple or held under rental, must be pursued. The land costs are represented by the rent, the building costs by the interest on the expenditures for the erection of these buildings, by insurance, etc., and the cost of floor space in any particular building is determined by adding the rental charge for land space occupied and the particular charges for that building, and dividing the total by the number of square feet of its floor space.

At the termination of the lease period the buildings under the usual ground rent plan revert to the original owner of the property, and their cost must therefore be written off by an annual amortization charge.

CHAPTER XIV.

MAINTENANCE AND DEPRECIATION.*

§ 120. Relation between Maintenance and Depreciation.

As applied to wasting assets, maintenance is the expenditure incurred for upkeep, while depreciation is an allowance for the lessening values inevitably brought about by use and the passage of time. Authorities are not fully agreed as to just where the line should be drawn between maintenance and depreciation charges. If a factory could be kept up to its original condition by repairs and replacement of parts, this would exactly offset the ordinary depreciation from wear and tear. In practice, however, this is impossible. Repairs are made where they are obviously necessary; replacement of parts are made from time to time; but no matter how careful the maintenance, there is a gradual and inevitable depreciation of efficiency value which must be reckoned with.

This inevitable and usually unpreventable lessening value of property as time passes, is properly a charge to depreciation. Many of the expenditures incurred in keeping the plant as nearly as possible in its original condition of efficiency are, however, of a doubtful nature, and it is frequently a perplexing question as to whether a repair or a replacement properly belongs to maintenance or to depreciation.

§ 121. Repairs and Replacements.

Repairs are a maintenance charge; replacements are a charge against depreciation. "It is often very difficult to distinguish between a repair and a replacement. A reserve for

* For specific discussion of maintenance and depreciation charges on factory buildings, see §§ 116, 117.

depreciation contemplates that the fixed assets to which it relates will be kept in proper repair, and that such repairs will not be charged against the amount reserved for depreciation. The cost of maintaining such fixed assets in repair is chargeable to the proper operating accounts. In the case of a manufacturing business the repairs to machinery and equipment are chargeable to Manufacturing Expenses account. * * *

"On the other hand, an article purchased to replace an article already charged to a fixed asset account should be debited to the proper fixed asset account, and the cost of the article replaced should be credited to the same account and debited to the proper reserve account, or to Surplus account if no reserve is provided. This establishes a consistent rule with respect to fixed asset accounts as follows,—*Always take out of the fixed asset account the thing replaced, and take into the fixed asset account the thing purchased to take its place.* In this way the cost of the things on hand will always be included in the balance of the fixed asset accounts.

"Of course this rule does not mean that a petty part replaced must be handled in this way, and herein lies the difficulty in distinguishing between a replacement and a repair. A repair is very often a replacement and it is often a matter of opinion and choice on the part of the bookkeeper as to whether a thing will be handled as a replacement or as a repair.

"No fixed rule can be given to govern such cases. If the entire machine is replaced by another machine, it is obvious that the old one should come out and the new one go in the fixed asset account. It would, however, usually be impossible for a bookkeeper to ascertain the original cost of a certain part of a machine that requires replacing if that machine was originally bought in its entirety. If a part that cost, say, over $5, was replaced, it is advisable to regard the expenditure as a replacement and charge it against Reserve for Depreciation of Machinery and Equipment. If a part costing less than $5 is replaced, it might be well to charge that

cost as a repair. In other words, it is not a good plan to be too free in charging items against the reserve account. That account should be capable of being readily analyzed, and a bookkeeper should exercise his best judgment in handling its debits. When an expenditure is made for the maintenance of a fixed asset, it is advisable that such expenditure be charged as an operating expense."*

Occasionally partial replacements may increase the value of a wasting asset beyond its original cost, as where a machine made of iron is replaced in part with steel, or a portion of a frame building is replaced with brick or concrete. In such case the replacement costs cannot wholly be charged to either maintenance or depreciation, but are more in the nature of a capital investment.

§ 122. Maintenance and Depreciation Charges.

When providing for maintenance and depreciation charges, two important features must be kept in mind:

(a) During the life of the asset its original cost together with all items of expenditure incident to its upkeep and operation is a proper charge against the production cost of the contemporaneous cost periods.

(b) During the life of an asset the aggregate cost of maintenance, depreciation, obsolescence, etc., should be fairly and equitably spread over the period in such manner as will give to each year its just and proper proportion.

§ 123. Elimination of Maintenance Charges.

Manufacturing concerns oftentimes increase their asset accounts by the happy-go-lucky method of adding thereto the cost of all alterations, renewals, and extensions of buildings and machinery, and then, as a concession to conservatism, charge a percentage of this total credit to Loss and Gain Account. In some cases even current repairs are charged to asset accounts. It is obvious that when these illogical and im-

* Bentley, "The Science of Accounts," pp. 194-196.

proper charges are made, a larger percentage must be reserved annually for deterioration.

Such methods amount in practice to an elimination of maintenance, and depreciation must then bear the added cost of maintenance charges; i. e., within the life of the wasting asset a sufficient amount must be written off as depreciation to cover the original value of the machine and the alterations, renewals, extensions, and repairs thereon, less any "scrap" value the asset may have at the end of its estimated life.

§ 124. Elimination of Depreciation Charges.

"In any particular building, machine or appurtenance, decay or wear of some sort must take place in the course of time and repairs in order to compensate fully for the decline in value must take the form of renewal. This being the case, the absolute replacement of some portion of the plant every year may thus maintain an average aggregate value. In only two kinds or classes of plant, however, can such an exact balancing of loss by repairs and renewals be ventured on. Where the plant wears out so quickly as to need replacement at short intervals, affording constant proof by mere continuance of working that not only the earning power of the factory is maintained, but also the capital value; and in a second class that of undertaking so large and permanent as to afford a wide average of deterioration and renewal over the whole plant."*

Unless considerable additions or extensions are made from time to time, the plan, sometimes followed, of absorbing repairs and renewals, as made, into production costs in lieu of depreciation, will not in the long run prove satisfactory. Provision must be made against the time when the machines will become obsolete and their operations a source of expense rather than profit. Likewise, changing conditions will in time necessitate the replacement of entire buildings. Such expenditures are usually far in excess of the ordinary annual

* Matheson, "The Depreciation of Factories."

expenditures for maintenance and depreciation. If, then, these extraordinary expenses are absorbed into the production costs of the period in which they are incurred, they will inevitably cause an excessive and misleading increase of costs for that period.

To prevent this, proper reserves should be made. In the case of buildings, amortization may be properly provided for through a reserve for depreciation, maintenance charges being absorbed through production costs as they arise. Replacement of machinery is best provided for by a reserve for depreciation.

Just how far expenditures for current repairs, and the renewals that may be necessary from time to time, will in themselves care for both maintenance and depreciation, depends largely upon the individual plant. In a large and long established factory a certain proportion of the whole might be renovated and even rebuilt every year, and this being spread over production costs might render a specific depreciation rate entirely unnecessary. Such a plan would, however, somewhat disturb the required conditions where a building space rate is applied to individual machines or industrial centers.

Kilns, furnaces, and structures of analogous character which are actually destroyed in whole or in part by their ordinary operations, may have to be rebuilt so often that this renewal or maintenance cost is properly absorbed into production costs and may thus obviate entirely the necessity for depreciation charges, as such.

§ 125. Absorption of Maintenance Charges.

Items of maintenance expense are absorbed into production costs either by making a direct charge as the cost accrues or by creating a reserve fund called "Reserve for Maintenance," and crediting thereto each cost period an arbitrary amount based upon an engineer's estimate or upon past exper-

ience, the offsetting charge going to the current expense account for maintenance costs.

This latter is the more equitable way, since it tends to keep the expense constant more evenly averaged. Thus, cases may arise where heavy expenditures are incurred for repairs in a single month or period, while for several months or periods following, but few if any repairs are necessary.

Also, as time passes, buildings and equipments are gradually reaching the repair point, and the cost of such repairs should be spread over the whole time during which the product is enjoying or is receiving benefit from these buildings and equipments, and not be loaded on to the cost in the special period in which the repairs or replacements are made. For this purpose a reserve or its equivalent is essential.

§ 126. Absorption of Depreciation Charges.

When allowances are made for depreciation, these are charged against production costs, and commonly the asset account receives the offsetting credit. As in the case of maintenance charges, a reserve against depreciation is a simpler and better method of handling the whole matter.

Thus, when depreciation is credited to the asset accounts and new assets are debited, as acquired, to these same accounts, their periodical balances do not show the total costs of their respective assets—which is the proper function of such accounts—but the total costs less the credited depreciation. Also, as the accounts do not show the cost of these assets, a calculation must then be made to arrive at the amount upon which depreciation must be charged for successive periods.

Under the reserve for depreciation plan, each building, machine, equipment, or other asset account is left intact, showing at original cost the assets actually on hand entirely unobscured by entries of a confusing or conjectural character. If an asset is replaced its account is credited with its original

cost, the reserve for depreciation receives a corresponding debit, and the new asset is debited at cost to the asset account.

§ 127. Factors Affecting Maintenance and Depreciation Rates.

Maintenance rates are governed so entirely by conditions that no fixed rule can be given for their determination. It is obvious that it will depend entirely on the character of the wasting asset, its use, and its surroundings. Where maintenance records for past years are accessible, these afford an excellent basis for determining the rate. Where they do not exist the matter is one of judgment and experience.

There is no generally accepted rate or scale for depreciation, and the matter is one upon which there is a wide diversity of opinion and upon which local conditions have a very material bearing. So far is this true that the whole matter resolves itself into an engineering proposition in which the depreciation records for past years will—if they have been carefully kept—figure largely.

Depreciation tables have been compiled for and are used by various organizations and underwriters. Valuable technical literature on the subject may also be found, but the conditions vary so greatly in different lines of industry and under varying systems of plant management, or even under different climatic conditions, that hard and fast rules cannot be established.

The actual deterioration of machinery and other utilities depends, as intimated, upon varying circumstances, some of which concern the device itself and others the manner of using it. Thus, in the case of a machine which has to withstand concussions or strains, the skill with which it has been set up frequently affects its life and efficiency quite as much as do the construction and material of the machine itself.

For the best results, the dimensions and strength of the foundation, or the weight of any frame-work or other fixed parts of a piece of machinery must be sufficient to absorb the shocks of impact without undue vibration. If this is not the case the constant strain will quickly throw the machine "out of true" and destroy its efficiency.

The same condition obtains where the machine is insecurely attached to its supports. In this connection the quickness of action of the mechanism must be considered as well as the force of the blows. A frame may be strong enough to withstand the strains of ordinary operation but not strong enough to withstand the quickly recurring strains of rapid operation. For slow speeds an approximate balancing of the moving parts may suffice, while for high velocities exact balancing and the most accurate fitting is necessary to prevent the machine or its supports from being shaken loose and destroyed.

It sometimes happens that the wearing parts of a mechanism have not been properly hardened and the effective life of the machine is thereby restricted, or if provision has not been made for the renewal of wearing parts, the effective life of the machine is limited to the life of these wearing parts.

It occasionally happens that workmen will substitute or tamper with parts of a machine in such manner as to diminish its term of usefulness. Thus, with some compressed air tools it is possible to foreshorten the stroke by cutting off a portion of the valve rod, force being thereby added to the blow. This gives the device a usage and strain for which it was not intended, and then its premature failure brings undeserved reproach upon its makers.

On the other hand, the life of a machine is lengthened by care in its installation, by care in its use, and by the replacement of wearing parts.

In addition to the actual physical wearing out or wasting of the particular asset, another form of depreciation must

be considered. This is the lessening or destruction of values brought about by the constant improvement in machinery. Although the manufacturer may be fully conversant with the trend of the times toward machine perfection, the future cannot be clearly foreseen, and there is always a possibility of an abnormal replacement cost due to the advent of new and more efficient mechanisms. Thus a new, up-to-date, and effective machine may have a prospective life of ten years or more. Within two years machines of such greatly improved efficiency may be placed on the market that the machine already installed must be "scrapped" as a mere matter of economic necessity.

All these varying conditions must be taken into consideration in fixing depreciation charges. In addition, the nature of the machine, the character of its construction, and the conditions under which it is operated, all bear directly on both maintenance and depreciation and must be given full weight in fixing the charge.

§ 128. Depreciation Rate.

The proper rate of depreciation for machinery and equipment is, as already intimated, a moot question. Even in well-managed factories of a similar character there is a wide divergence of practice. This is due partly to varying conditions and partly to the divergent views of those in control.

Under ordinary circumstances the average rate which will meet the deterioration and contingent risks in factories will generally be found between 5% and 10% per annum. Where work is moderate, not straining the machine severely, and where the hours of work do not average more than sixty per week, 5% will generally suffice for the wear and tear of machinery, cranes, and fixed plant of all kinds, save steam engines and boilers.

Where there is a diversity of machinery and plant conditions, and the records of past years are accessible, an approximately fair rate of depreciation may be arrived at by

comparison of these records, and this rate once fixed can be checked up and changed from time to time as the actual conditions seem to require.

The life and value of steam engines and boilers is a difficult question, varying in almost every case. If classed separately from the other machinery of a factory, steam engines and boilers generally require a higher rate of depreciation than the other machinery, and if again separated, boilers demand a higher rate than engines. In the case of an ordinary type of well-made, stationary engine and boiler, it is the part of wisdom to write off or reserve 7½% the first year and 7½% annually from the diminishing value or its equivalent. This will usually be found ample, if the minor repairs and renewals, such as new bearings, grate bars, etc., are duly made and absorbed in the expense burden.

Under this rate an original investment in engines and boilers of say $5,000 would show on the books at the end of ten years at a depreciated value of $2,293.75. If at this time the cylinder of the engine be rebored and possibly a new piston supplied and the boiler be renewed by the insertion of a new furnace at a total cost of say $600, this sum might be added to the capital value, and the depreciation rate of 7½% be continued over a further five years until the value is reduced to $2,275. A new boiler would probably be necessary by that time, and when this new boiler is installed the rate of 7½% could then go on the renovated value. As, however, a depreciation fund is generally intended to include a reserve for contingencies other than mere wear and tear, it is a wise course to begin with a maximum rate in excess of 7½%.

In every large plant there is usually an accumulation of unused machines, tools, and patterns. These should be valued at a percentage of their net cost of replacement if there is any possibility of future use of their functions. Equipment wholly obsolete should be considered simply as scrap, but if a machine obviously obsolete for its destined functions

is still used for certain operations which it performs sufficiently well, or if a die is kept on hand for occasional orders coming in which require its use, such appliances are still entitled to a place in the inventory at some fair ratio of their original cost.

If there is any question as to the value at which these semi-obsolete appliances are to be inventoried, a professional appraiser, coming from the outside with no preconceived ideas or prejudices, and with previous experience and observation to guide him, is the fairest and safest arbiter.

§ 129. Purpose of Depreciation Charges.

There are various methods of estimating the depreciation of a factory and of recording alterations of value, but in all of them the end to be attained is to harmonize the investment in wasting assets as shown by the financial records of the concern with the real value of such assets; i. e., the investment in assets as shown by the books at any particular time must as nearly as possible be the real value of the assets at that time.

The more important of the differing methods of providing for and apportioning depreciation charges from year to year and of bringing book values and real values into harmony as far as may be, are described in the following sections.

§ 130. (1) Depreciation Determined by Appraisals.

Under this method wasting assets are revalued each year, speculative features being excluded, and whatever loss such valuations reveal are absorbed into production costs without regard to any prescribed rate.

In some factories there are a few chief items of plant or equipment which are more important than the rest, the condition and value of these items therefore requiring consideration of a specific nature such as an annual appraisal. Again, some wasting or diminishing assets depreciate far more quick-

ly than others—as for instance, work horses—and it is quite advisable to entirely revalue such assets at regular periods. For such items the plan discussed is advisable. It is not, however, generally feasible and is only advantageously available in plants where the conditions are simple and uniform and where difficulties would be encountered in the use of a monthly cost period.

In some ways, it is true, the plan of annual appraisals, where it is applicable and is properly carried out, is more accurate than that of a depreciation rate. The excessive deterioration of periods of heavy work, or the lessened wear of slack periods, is properly distributed. The plan has, however, serious defects. A mechanism may be installed and even after years of use be apparently as good as new, but nevertheless its term of actual usefulness is steadily waning and a replacement is finally required. Or, worse still, at any time a new device may appear which will "scrap" the mechanism no matter how good its condition. In either of these cases an abnormal depreciation cost is thrown on the particular period.

If cognizance is taken of this lack of the appraisal plan and some fixed amount is written off the value of the wasting asset regardless of appraisal adjustments, the defect is cured but in doing this the plan of a depreciation rate is in fact adopted.

§ 131. (2) Depreciation Based on Maintenance Charges.

Under this method the actual amounts expended for repairs and small renewals are charged against costs, and at the same time an equal amount is set aside against the original cost of the asset to cover depreciation. The method assumes that in the earlier life of the asset it depreciates but little, the great shrinkage of values taking place in later years.

It is true that whatever is spent to counteract the results of age and use, tends to lessen the amount of depreciation, and also that the ordinary factory utility depreciates but

little in the first few years so far as efficiency of production is concerned. This, however, is no true measure of depreciation, and the years of low repairs should see a much larger writing off of values than would be possible under the plan here discussed. Under it the heavy burden of both repairs and depreciation comes in the latter years of the life of the asset, and the burden on costs is then correspondingly heavy and inequitable.

§ 132. (3) Annual Percentage Allowance for Depreciation.

Under this plan the actual amounts expended for repairs and small renewals are charged to costs and in addition costs are charged for depreciation with a percentage on the reducing annual value of the asset. This percentage is calculated at such a rate as to reduce the asset to its actual intrinsic value by the time it becomes useless for its original functions.

By this means the direct charge for depreciation is gradually reduced from year to year. The plan is advocated on the two grounds (a) that repairs and partial renewals of the asset will probably increase steadily, and (b) that the earning capacity of the asset will probably decrease as it becomes older.

As a producing mechanism is in its early years competing for the most part against older machines, and in later years against newer machines, it is argued that it can afford to bear heavier charges in its earlier years than it can in its later years. As a matter of fact new inventions or new processes may at any time change the methods of manufacture and render old machines obsolete; and from this point of view the early reservation for replacement is a matter of prudent conservatism.

The methods of determining the arbitrary depreciation rate are various. It may be worked out by elaborate mathematical formulæ, but since the rate is at best more or less arbitrary, simple arithmetic is adequate for all practical purposes. The difference between the cost value of the asset and

its scrap value represents the shrinkage which is to be divided over the estimated life of the asset.

A satisfactory method is to depreciate each year by a fractional proportion of the total shrinkage, the fraction expressing this proportion having for its numerator the number of years of life the asset has yet to run, and for a common denominator the sum of the year numbers constituting its life. For example, if the estimated lifetime of a given device is five years, the sum of its life years is $1+2+3+4+5=15$. This gives the denominator of the fraction. In the first year the asset having five years of life before it, an amount is written off equal to $\frac{5}{15}$ of the total shrinkage to be disposed of; the second year $\frac{4}{15}$ are written off; the third year $\frac{3}{15}$; the fourth year $\frac{2}{15}$; and the last year $\frac{1}{15}$.

This method applied to a device costing $400 and assumed to last five years with a final intrinsic value of $25, would work out as follows:

$400.00 — $25.00 = $375.00 shrinkage to be written off.

Year	Depreciation	Amount of Depreciation	Value of Depreciated Asset
1	5/15 (of $375)	$125.00	$275.00
2	4/15 (of $375)	100.00	175.00
3	3/15 (of $375)	75.00	100.00
4	2/15 (of $375)	50.00	50.00
5	1/15 (of $375)	25.00	25.00

The illustration shows a depreciation of one-third of the total shrinkage in the first of the five years and of only one-fifteenth in the last. This appears to be a fair distribution for so short a life period.

§ 133. (4) Depreciation Charges in Equal Annual Instalments.

Under this plan the total sum to be charged against production cost during the life of the asset in respect of repairs, partial renewals, and original purchase price is estimated in advance, and each cost period an equal fraction of such total is charged to product.

The method is a more or less broad application of the

law of averages. It assumes that so far as deterioration and shrinkage of values is concerned, all the years of life of the asset are practically equal.

It is maintained by some that the more delicate and intricate devices should be subjected to a higher rate of depreciation than is given the more simple mechanisms. Superficially this appears to be so; yet on a closer analysis the contention is not always sustained,—at least in those cases where maintenance of factory utilities is charged to manufacturing expense in addition to a percentage of depreciation. Under these conditions the upkeep of the complicated device will be much more expensive than the maintenance of the simple device, but while this is so, the ratio of depreciation will not be affected for the reason that the upkeep expense prolongs the life of the complicated device until in most cases it equals the life of the simpler machine.

This method has the advantage of "levelling up" the charges against production costs in respect of repairs and small renewals better than any of the preceding plans, but as it is based upon estimates, it must be adopted with caution, unless the experience of the past affords a basis for accurate estimates for the future. When it is applied to the plant as a whole, it partakes somewhat of a "blanket" method and is liable to break down on occasion, and, particularly in large and complex factories, give results far from the truth.

This is so because in such cases the depreciation goes on at a very uneven rate in different parts of the plant, for different mechanisms, and at different times, and a blanket method fails entirely to distribute the burden of depreciation equitably. The results are still farther from the truth when some departments are working at full capacity while others are in a state of complete or semi-idleness.

§ 134. (5) Interest Included in Depreciation Charges.

Under this method the amount charged to production costs includes an allowance for interest on the investment.

This plan is in fact merely the specific addition of simple interest to one or another of the plans of the present enumeration. This interest on investment is not in any manner taken out of the business, but, on the contrary, appears on the credit side of loss and gain as an earning of capital. This is quite the reverse of the plan considered in the next section, wherein the principal represented by a sinking fund is actually set aside, the interest being provided for by the investment or other use of this sinking fund.

§ 135. (6) Sinking Fund for Depreciation.

Under this method a sinking fund is established for the renewal of the asset at the expiration of its estimated life, the annual instalments of the sinking fund being absorbed by production costs, together with either the actual or average expenditure upon repairs and small renewals.

This plan contemplates a sinking fund to be actually set aside and put out at interest so that the earlier instalments will increase by compound interest, the total amount of sinking fund and interest providing a sufficient fund in the period of the asset's life to equal the difference between this first cost and its scrap value.

When production cost is charged with a provisional amount for depreciation, there is, of course, a reserve of assets in some form to a corresponding amount. "Active assets" are increased to an extent corresponding with the estimated decrease in the values of "passive" or "fixed" assets. There is, however, danger that if these reserved assets are not specifically allocated they will become "tied up" and be not readily available for purposes of renewal when the proper time arrives. For this reason a sinking fund consisting of actual cash set aside for the purpose of renewals, is preferable to an accounting reserve. This is not so necessary when the sum that can be expended for renewals in each successive year

is approximately uniform, but otherwise some systematic plan of actual segregation is distinctly desirable.

The amount to be annually set aside for sinking fund purposes under the present plan resolves itself into a problem of compound interest. What sum shall be invested each year at compound interest to equal the total shrinkage in value of the asset in the period of its life. Suppose the total estimated shrinkage in value of the asset is $375 and equal annual instalments are to be set aside for say five years at 6% interest compounded annually. Then taking the usual basis for calculation of compound interest:

$1 invested for 5 years will amount to	$1.338
$1 invested for 4 years will amount to	1.262
$1 invested for 3 years will amount to	1.191
$1 invested for 2 years will amount to	1.124
$1 invested for 1 year will amount to	1.060
	$5.975

$5.975 represents the accumulated total when $1 is invested each year for five years at 6% compound interest, computed from the first of each year. This divided into the amount to be provided for—$375—gives the necessary annual investment. The detailed results of this investment are given in the following table:

Year	Installment	Compound Interest	Sinking Fund	Machine Value
1	$62.76	$ 3.77	$ 66.53	$333.47
2	62.76	7.78	137.07	262.93
3	62.76	11.99	211.82	188.18
4	62.76	16.44	291.02	108.98
5	62.76	21.22	375.00	25.00
	$313.80	$61.20		

As will be seen, the actual reservation for each year is approximately 16.73%. The percentage must, of course, be larger if the sinking fund is not actually reserved or is not put out at interest.

If desired, the sinking fund method of providing for depreciation may be employed as supplementary to any of the other methods of the present enumeration.

§ 136. (7) Reserve Fund for Depreciation.

Under this plan a reserve fund is provided for the renewal of the asset at the expiration of its estimated life, the annual or monthly instalments of this reserve fund being absorbed by production costs, together with either the actual or average expenditure upon repairs and small renewals.

This plan is very similar to that outlined in the preceding section, the most important difference being the fact that instead of the creation of an actual fund invested outside the business, the amounts applicable to the reserve fund are retained in the business, any interest earnings thereon appearing as an earning on capital in the Loss and Gain Account. The same plan may be worked out with any of the other methods of providing for depreciation.

When a reserve fund of this kind is established, the asset values of the buildings and equipment depreciated should be left on the various ledger accounts undisturbed save as new assets are charged in at cost plus the expense of instalment, and the old assets are charged off at their original cost. Each asset account then shows the actual cost of its assets on hand. The charge made each period against the expense account "Depreciation" should be passed to the credit of a reserve account called "Reserve for Depreciation." As already intimated, these charges should not be applied to the credit side of any of the various asset accounts.

The Reserve for Depreciation Account appears on the credit side of the balance sheet as a liability; or the better method may be pursued of showing the assets in the balance sheet during the continuance of their life, subject to deduction of the credit balance of the Reserve for Depreciation Account.

§ 137. Depreciation of Patents.

When the acquisition cost of a patent represents only such expenditures as have been incurred in obtaining letters patent from the government and in subsequent protective litigation, or perhaps the cost of securing patent assignments or shop rights from other persons, there is no question as to the validity of the asset. Such costs should be absorbed by a proper depreciation spread over the life of the patent.

In view of the fact that valuable patented devices are quickly imitated and shrewd minds are constantly endeavoring to evade or supersede important patent claims, the advent of a competing and equally valuable patented device is always a possibility. For this reason it is wise to absorb patent costs largely if not altogether in the earlier part of the term of validity.

The author is strongly of the opinion that patent costs have no real place in production costs, inasmuch as patent protection is purely of a commercial nature. Morever, a segregation of patent costs over departments could not be made on any logical basis, and if made on some other basis would entirely lose its value for any purposes requiring a cost per unit. The better plan, therefore, is to absorb patent costs into commercial costs, keeping the item so segregated that if its consideration becomes at any time desirable in connection with production costs it may be readily accessible.

When royalties are paid they are usually a unit charge and easily allocated, either as a production or commercial cost as may be desired. There is, of course, no question of depreciation involved when royalties are paid on any ordinary basis.

Where patents are capitalized at an inflated or fictitious value, the account then becomes analogous to a good-will account and should be treated in a similar manner.

§ 138. Depreciation of Good-Will.

Good-will requires but little consideration here as, speak-

ing generally, it is purely commercial in its nature and has no proper place in factory production costs.

If the amount paid for the good-will of a going concern be small, it may be absorbed in the earnings of the first few years, or it may be left to be written off against the surplus profits of a prosperous year. Where the value of good-will is successfully maintained by specific expenditure, the writing down may be less severe, or the account may be left intact.

In the case of trade-marks that have been so long or widely established as to insure a regular or profitable flow of business, the good-will forms so real and important an asset that it would be erroneous to cancel it entirely in the capital accounts.

CHAPTER XV.

POWER COSTS AND LOCAL TRANSPORT.

Power Charges.

§ 139. Segregation of Power Costs.

In many cases the cost of power is diffused over product as a merged item of the general overhead expense. Where costs are desired in their form of highest usefulness—a form which will give a reflection of conditions as well as of actual production price—power must be segregated and charged as a direct expense. If it were purchased from outside sources it would be so treated as a mere matter of course. "That the manufacturer undertakes to make his own current or supply himself with his own power is no good reason for not ascertaining what it costs him in the form of a definite rate, just as if he had purchased it from outside. Indeed it is the very best reason for reducing his power expenditures to such a rate."*

It must also be borne in mind that the chief engineer in his capacity as a department head has his own problems to solve in reducing and keeping down the cost of his unit of production. The treatment of power as a direct expense will aid him greatly as showing clearly the various costs, leakages, and the directions in which economies may be effected. Therefore, both as a matter of accounting statistics and to aid the engineer in maintaining the proper low level of power costs, full and accurate power house records should be kept and reports should be made daily or weekly to the cost department. Figure 155 shows a form of report used for this purpose.

* Church, "Production Factors," p. 90.

§ 140. Determining Power Costs.

In working out power costs as a direct expense, the power plant must be treated as entirely separate from all other departments. It must therefore bear its proper assignment of building space values, and of interest charges on power house machinery and equipment; proper reservations must be made for its maintenance, repair costs, and depreciation; and all this in addition to the more obvious items, such as fuel, firemen, and engineers which in many cases constitute practically all that are considered power costs.

It must also be borne in mind in considering the power plant that there are other channels besides power into which the efficiencies of the power house may be diverted. Thus in many cases live steam is used for heating throughout the plant. In other cases exhaust steam is used for this purpose during working hours, and live steam is generated during inactive hours, to maintain the required temperature for certain classes of machinery and product. In some plants live steam is used for boiling water and for drying.

In determining the cost of power, these other uses of power house steam must, of course, be taken into account. It is obvious that each has a value which must be determined and subtracted from the total expenses of the power house before the real cost of the most important power-house product—horse-power—can be properly determined.

§ 141. Distributing Power Charges.

Whatever the system of cost finding employed, it is clear that the power consumed by each separate department should be charged to it at a predetermined price based on the horse-power consumption.

Within the department, the power used by each individual machine must be determined. This is readily done by means of the transmission dynamometer, which is really a power-weighing scale inasmuch as in use it is interposed be-

tween the source of power and the particular machine so that the power which actuates the machine must pass through the dynamometer, and this power is then determined by the dynamometer as the ordinary platform scale determines weights. Each machine is tested under the varying conditions which obtain in its actual operation.

The dynamometer can also be used to determine the power absorbed by the line and counter shafting in each separate department, the mechanisms being, of course, idle while the test is being made. It is obvious that the power thus obsorbed in the line and counter shafting of a department added to the power requirements of each machine of that department, will give the total power required for the departmental operations.

§ 142. Power Formulae.

In many lines of manufacture, formulae may be found for determining the driving power required for the mechanisms ordinarily employed. Thus in a cotton spinning mill the following predetermined numbers are taken as a basis for calculation*—30 for a mule mill and 20 for a ring mill. Either of these numbers plus the counts spun, divided into the total number of spindles in the mill, gives the approximate horse-power. Under this formula a ring mill containing 50,000 spindles spinning 30's counts, shows the following equation:

$$\frac{50{,}000}{20+30} = 1{,}000 \text{ (horse-power required to operate mill)}$$

§ 143. Electric Motors.

Where electric motors are used, the question of determining the power cost for each department or for individual machines is a comparatively simple matter. If the power is purchased, a meter for each separate department will give its actual consumption, from which, at the fixed rate, its proper power charge is readily obtained. If the power is developed

* The Cotton Year Book, 1910, p. 369.

in the factory, department meters will still give the consumption of electricity in each department and give a basis for determining its proportionate part of the entire cost. To determine the power used by individual machines, ammeters are employed, from which a number of readings are taken under the different conditions of work, these readings being averaged on a fair basis.

Where a particularly accurate application of power costs is wanted, as for instance where the machine-hour plan of cost finding is employed, a systematic and thorough test must be made of every motor drive in the plant. This test will determine the high point and the low point on a steady load, and the high point when a spurt is made; after which the reading of amperes can be averaged, and this average multiplied by the voltage will give the number of watts. The watts divided by 746 will give the average electrical horse-power for each hour of active use.

When the power unit is levied against departments as a whole and not against individual machines, the power consumed by the department may, as stated, be determined by direct metering, or, otherwise, the active hours per day of each machine may be multiplied by the rated E.H.P. used by it. These totals added will give the total number of E.H.P. hours per day for the entire number of machines in the department, which divided by the number of working hours in the day will give a very fair approximation of the average E.H.P. used by the department.

Professor H. C. Bartholomew, of the Department of Electrical Engineering, Iowa State College, in commenting on this method of determining the E. H. P. consumed by machines and departments, says:

"Another scheme would be to connect an integrating wattmeter into the circuit of each motor for say a day or a week and take readings. This would give an accurate result but would leave out the factor of the maximum demand which

your method includes. Under some conditions your method would answer very well, always supposing it is a direct current installation. The power taken by the alternating current motors is not equal to the product of volts and amperes on account of the influence of the power factor and also on account of the fact that usually such alternating current installations are three phase, with three mains running to the motor. As a rule the unit of energy on which the charge is based is the kilo-watt hour, although sometimes in industrial plants it is the horse-power hour or the horse-power year. The rate is usually based on the average amount of power used or on the maximum demand and there are nearly as many different systems of arriving at the rate as there are central stations."

§ 144. Compressed Air.

When compressed air is used as a driving force, the average amount of air used by each department of a factory may be equitably determined in several different ways.

Reliable meters may be secured for measuring air flow, and afford the simplest method of determining departmental air consumption. If properly used these meters will also give reliable readings for individual mechanisms. For this purpose the meter must not be placed too close to the mechanism to be tested, as, in the case of tools in which the flow of air is intermittent, such as riveters, this irregularity would affect its reading. By the use of the meter the constant of air consumption for each tool of each department can be determined.

A formula used in arriving at compressed air power is as follows:*

$$\frac{PLAN}{33{,}000} = 1 \text{ H. P.}$$

P is the pressure of the transmitted air in pounds per square foot; L is the length of piston stroke in feet; A the area of piston in square feet; N the number of strokes per

* Use suggested by F. Herlen of B. F. Sturtevant Co., Hyde Park, Mass.

minute. In finding the horse power at the main compressor, N will equal the number of revolutions per minute. If the machine is double-acting, L will be the full stroke forward and backward, but if single-acting, the length of the single stroke.

When a charge for compressed air is to be spread over the departments and not to individual mechanisms, the consumption can in the absence of a suitable meter, be determined approximately by closing down the tools in all departments save one for a short length of time and then testing the operating department, the test being made brief in order that it may not prove too costly in time and labor lost in the other departments. During the time of the test all the individual air devices in the department are used on work involving their maximum capacity, and the indicator is read at the compressor. This operation is repeated for each department.

As the reading is of maximum consumption, it is a foregone conclusion that the record for each department will be very much higher than the actual amount of compressed air used at any one time in that department. The sum total of the readings taken for all the departments may even be several times the capacity of the compressor. The proportion, however, holds. Hence the method will give the proportionate cost of compressed air to be borne by each department, although these proportions may not be a fair basis of diffusion, since in some departments the use of air may be almost continuous while in other departments it may be used intermittently.

There are, of course, many variables and losses to be considered in determining air consumption. The strokes of most of the pneumatic tools are different; the same law of consumption that applies to pneumatic tools does not apply to air hoists and to pneumatic hammers and riveters; also leakage is an important factor; and still further the style and type of compressor, the make of the tool, and even the men

operating the tools, are all factors which may affect the consumption of air. In this as in all elements of production cost, the manufacturer is confronted with an actual condition and not a mere theory. He must distribute his cost as accurately as conditions will permit, but to attempt too fine a distribution will surely result in unreasonable trouble and expense and possibly a less accurate distribution than under a more reasonable plan.

The author, however, believes that except in cases where all or nearly all the employees use a similar air tool, as in the cleaning department of a foundry, it cannot be considered a "more reasonable plan" to diffuse the expense through the overhead cost.

§ 145. Unit Standard for Air Consumption.

If from the air devices in a given department the one of smaller listed air capacity be chosen as a unit, then each of the other devices, technically considered as to variations on account of physical condition, possible leakage, etc., may be reduced—on the basis of listed air capacity—to the same unit standard. If all these units in a given department are added and this total is divided into the amount shown on the gauge when the department test is made, the result should be a fair actual consumption per unit in that department.

Thus, if the capacity of the smallest tool in a given department is represented by x, and the total capacity of all the tools in the department is 18x and the gauge shows the air consumption to be 196 lbs., 1x will equal 10.66 lbs. When this has been determined, an average daily use of each air device is approximated as closely as possible, and this multiplied by the capacity of the individual machine, will give its daily air consumption.

After the unit cost for a department is found, no further use will be had for the record reading of the departmental test (total air used) unless, perchance, it be in making tests

for possible leaks between the compressor and the department limits.

The air consumption of each department combined into one total, and divided into the total cost of operating the air compressor, gives the unit charge from which may readily be derived the proper charge for each department.

§ 146. Specific Plan for Determination of Air Consumption.

Where a more accurate determination of air consumption is desired than is possible under the preceding plans, the author would suggest the following method. The actual use in hours each day of each air device is approximated as nearly as possible. Usually the manufacturer's catalogues will give the air consumption of the particular tool as determined by the maker. If the manufacturer's statement is not available, the air consumption of the tool must be calculated.

For this purpose the length of stroke in inches, the number of strokes per minute, and the diameter of the cylinder in inches are multiplied together. This result is multiplied by the actual use each day expressed in hours. The cube root of this last product gives the compressed air unit.

The compressed air units for the various air devices in the plant are properly listed in the "Compressed Air Units" column of the Term Cost Record (see Figure 191), a footing is made of the total number of units, and this total, divided into the cost of operating the air compressor, gives the cost per unit. This cost should be obtained each successive period and applied to the various tools and cylinders operated by compressed air according to their constants.

The plan outlined for determining the cost of compressed air consumed was submitted to a number of prominent mechanical engineers for an expression of opinion. The comment received is interesting and of considerable technical value. Much of it applies to other forms of power determin-

ation as well as to compressed air and is therefore reproduced at length.

Professor Arthur J. Wood, Department of Engineering, Pennsylvania State College, says: "At the best, your cube root constant is not fair to all sizes of cylinders as can be readily shown, and your leakage may be an important factor. For these and other reasons, it is a question if you can reduce this particular problem to your 'constant' basis applicable to *all shops*. It impresses me that one of the best ways to proceed is as follows: Determine the capacity of the compressor, also of those machines,—as air hoists,—using a fairly uniform supply of air from day to day, which can be pretty accurately determined; find the losses from leakage by having the machines cut out of service and the compressor working slowly, and further find the capacity of the smaller tools by a difference of the total and the consumption mentioned above. Knowing the capacity of the compressor and the cost of compression, the cost of the air for the different tools in any case can be approximated and a unit value estimated. Where the work is intermittent and the tools used are of different sizes and makes, a simple approximate method must be adopted. You have brought out the broad principle which can be made to apply to particular cases; but in any case, your 'unit of cost' should be on the basis of the volumetric capacity of the machines and tools."

Professor Arthur J. Frith, Department of Engineering, Armour Institute of Technology, says: "I notice that you have incorporated something in regard to the length of stroke and the number of strokes in the determination of your unit; also that you take the cube root of the products for comparison. I do not think you are justified in so doing. What you require are volumetric indications which vary possibly as the cube of some similar dimension, but I can think of no relation that varies as a cube root. I would suggest that the unit of each tool be established by multiplying the square of the

diameter of the cylinder by the length of the stroke, taking air at full pressures; that is up to the point of cut off. Multiply this by the average number of single strokes and by the average number of hours per day.

"Such a figure, if determined for the smallest tool, might be as you suggest, used as a unit for the rest and should give a fair operating cost to each department and tool using compressed air."

F. G. Coburn, M. S., Construction Corps, U. S. Navy, has this to say: "In the case of a plant doing any considerable amount of jobbing work on the basis of cost plus a percentage for burden and profit, I consider the tool charge plan preferable; but for a strictly manufacturing plant, particularly when the air tool equipment consists largely of 'utilities' such as hoists, etc., the method of carrying the air charges into the department expense appears preferable. This question is, however, purely one of expediency, and its solution is controlled by local circumstances.

"The method of distributing the charges for compressed air among departments by testing each department separately for its maximum consumption, and distributing the charges in relation to the ratio of these maxima, has this principal fault, that it is not only likely, but in my line of work common, for a shop having a large total capacity for air consumption actually to use a very small ratio of its total capacity, and hence, without further analysis, I believe such a method to be dangerous.

"Of your two methods for this further analysis, I would say that in my opinion the first method is preferable to the second. In your second method you arrive at your compressed air unit or tool constant by taking the cube root of the product of two linear functions, thus arriving at a function of a semi-cubical order. Now, I presume that you arrived at this method after considerable experiment, and that you have tested it out. But on account of the order of this function, I

think you will see plainly without further comment on my part that it is apt to prove misleading, and as a misleading method is dangerous, I would prefer the more rational, though apparently more approximate, method outlined in your first alternative, that of estimating the relative capacities of the tools in each department, and the relative daily use of each tool, arriving at a pound-hour constant.

"Such a method can be very well checked and assisted by the use of an air flow meter; * * *. Then by the method outlined in your first alternative, a very satisfactory pound-hour unit can be arrived at which will take account of leakage, and this your semi-cubical constant does only imperfectly.

"This is noteworthy because different departments have different percentages of leakage and waste. If you will consider, for example, a shipyard or a large locomotive repair shop, you will see that in the shipyard the structural iron workers on board a ship make a very large waste, due to long leads of air and the many couplings and possibilities for leakage; and that in the locomotive repair shop the workers or the locomotives themselves occasion much loss for the same reasons. On the other hand, in the shipyard or in the locomotive repair shop, in the boiler shop proper the losses on this score will be comparatively small, yet the same kind of tool is used on board ship as in the boiler shop.

"I am very much impressed with this first alternative of yours and think it on the whole is a good one, and one that is not misleading.

"With further reference to the air-flow meter, I would say that this is a valuable adjunct to any large plant, not only because it is of great assistance in arriving at the methods for diffusing compressed air charges, but because it can be continued in use to watch for leakages, inefficiencies of transmission, etc., thus being not only a check on the costing method adopted, but a check on the operating efficiency. I consider

the purchase of such an instrument as an investment and not an expense."

Professor Harry C. Fetsch, Department of Engineering, Ohio Mechanics Institute, offers the following plan: "It appears that a method of arriving at cost of operating various air machines can be worked out using a general system of averages. It must be, however, undertaken only when the machine is operated very frequently so that the average obtained represents a good average, as will appear in subsequent outline and example worked out.

"The following is the general scheme of procedure:

"Determine average volume of cylinder, by taking cross section area and multiplying by average length of stroke.

"Find average number of strokes per day.

"Find average load on hoist per day.

"Determine the number of cubic feet of air (under working pressure of compressor) used per stroke.

"This volume times the number of strokes per day gives the total volume of air used per day.

"This volume times cost of air at compressor gives the cost of air used per day by the machine.

"Cost at compressor may be determined by test, or use manufacturer's figures.

"As an example let us assume an air hoist and working conditions as follows:

Diameter of cylinder ..... 10 in.
Average number of strokes per day..... 100
Average length of stroke or lift as determined by observation ..... 3 ft.
Average working load on hoist..... 5,000 lbs.
Air pressure, 1 square inch..... 80 lbs.

"The pressure of air in the cylinder with a load of 5,000 lbs. on hoist is found by dividing the load by the area of piston in square inches, thus:

$5{,}000 \div 78.54 = 63.6$ lbs. to 1 square inch.

Correction for piston rod: If we assume a piston rod of 2 square inches sectional area, this will reduce the effective area to 76.54 sq. in. and the pressure in cylinder then becomes 65.3 lbs. to 1 sq. in.

"The working volume of cylinder is equal to the piston area times average lift, or

$$\frac{76.54 \times 36}{1728} = 1.59 \text{ cubic feet.}$$

"Now we have a volume of 1.59 cubic feet of air under a pressure of 65.3 lbs. to 1 square inch; how many cubic feet of air at 80 lbs. must be taken from the compressor to give 1.59 cubic feet? This may be closely approximated by making use of the law which states that the product of pressures and volume is a constant, thus:

$$80\ v = 65.3 \times 1.59$$
$$v = 1.297 \text{ cubic feet, say } 1.3 \text{ cubic feet.}$$

"If the machine is in operation 100 times a day, it will take 130 cubic feet of air at 80 lbs. pressure per day. This value multiplied by the cost of air per cubic foot for compressing the air, gives the cost of the air in this machine per day.

This method of arriving at cost of operation may differ considerably from your plan for determining some constant. In this case our constant is simply the cost of air consumed per day."

Local Transport.

§ 147. Local Transport Systems.

Transportation costs on incoming freight are for the most part a direct charge against material and supplies. Outgoing transportation on freight is for the most part a commercial expense, which has no place in production costs.

Where plants are of such size, or so located, or so faulty in arrangement as to make local transportation, whether in-

terdepartmental or otherwise, an item so material as to require separate handling, the charge is for the larger part a production cost, which must be equitably allocated over product.

In the larger plants local transport frequently requires a system of standard or narrow gauge tracks with private engines or trolleys for traction purposes. Sometimes traction service is obtained from the local railroads, perhaps as part of the regular car delivery service or perhaps as a matter of independent contract.

The shifting of loaded cars of coal, pig iron, sand, lumber, etc., or of outgoing finished product, scrap, rejected material, ashes, slag, etc., is the usual work of the local transport service. In addition to this it may be engaged in transporting materials in process from one building or department in the plant to another. This does not necessarily imply a poor arrangement of the plant, particularly when it is a large one, but, regardless of the cause, it is a service to production which must be properly separated and charged.

Devices such as belt or bucket conveyors which constitute a distinct and exclusive service between certain departments, need hardly be considered in this category; i. e., the cost of such service may be levied upon the department or departments directly benefited without connection with any other transport charges. The same may be said of overhead traveling cranes where the cost is distinctly applicable to a certain department or departments.

If, however, either belt or bucket conveyors or travelling cranes are used to handle material between points inaccessible by the railway, or to give a transfer service between standard gauge cars at one point and industrial railway cars at another, or to serve distinctly in any other way as a portion of the local transport service, they should, of course, be included as a part of the system.

§ 148. Application of Local Transport Charges.

The application of local transport charges is best effected

by the machine-hour plan of cost finding. Where the service consists of an industrial railway, the charges to be applied will include the cost of land occupied, of trackage, equipment, building space occupied, fuel, electric current, supplies, labor, etc., etc. Crane service, hoists, and analogous items, as already suggested, can be handled either as part of the local transport system, or when more convenient as part of the departmental equipment.

The costs so found are not to be spread over departments on the arbitrary basis of a broad percentage, but on the basis of service rendered, cognizance being taken of tonnage, bulk, and number of transactions. It will, of course, be recognized that the value of the commodity or material handled in nowise enters into the calculation. Thus, the transfer from one part of the works to another of a carload of sand costs no more nor less than the transfer of a carload of castings of perhaps a hundred times the value.

As in the case of other utilities, the local transport is from time to time subject to feast and famine conditions. Hence it is difficult to establish a fixed rate of charges for its service. As a comparatively simple method of securing the proper approximate charge, the author would suggest a system of points to be used after the manner of the freight tariff.

Under this system the simplest service performed by the local transport is taken as a unit and is given a rate of one point. Every other service rendered by the local transport is compared with this unit and assigned such number of points as shall seem equitable after a careful study of conditions. Tests should be made, where possible, to prove the continuing accuracy of the rating.

When the rating has been established, a daily report from the local transport department showing by tally marks exactly what has been done, affords a simple and accurate basis for assessing the costs. The total number of tally marks under each service is multiplied by the number of points

scheduled in the local tariff for such service. It is not necessary to reduce the service to points each day except when desired for the sake of an efficiency record. If merely used as a means of assessing charges, the tally marks may be left until the end of the month or other cost period, when the total number of points involved is determined and divided into the total cost involved, thereby arriving at the rate per point.

§ 149. Record of Cars Handled.

In the case of large industries where local transport is a necessary and important feature, it is customary to employ a yard superintendent or foreman, and the work usually resolves itself into a daily routine, largely governed by the schedule of train arrivals and departures on the freight service of connected railways. Records must be kept of car handlings (see Figures 47-49), and brief reports can be made of interdepartmental transactions. This is most conveniently done by report slips of the usual transfer form so that a mere check against the proper item will serve to record the car transferred.

CHAPTER XVI.

INTEREST, DISCOUNT, WASTE, AND VARIATION.

§ 150. Commercial Interest.

When money is borrowed for the purpose of carrying an abnormal accounts receivable list, the interest paid on such money is a purely commercial cost, with no place in production. Obviously there is no justification for "penalizing" production because of the long datings of the sales department, or the inefficiencies of the collection department.

Likewise, where money is borrowed to discount purchase invoices, or to enlarge the operations of the business—save by investment in plant, machinery, or materials—the interest paid is a commercial expense properly charged as an offset to a revenue account.

Interest on plant investment, including not only the investment in the permanent assets of the plant, but also in the materials and goods in process, is, as discussed in Chapter XII, an important factor of cost and is properly charged to production.

§ 151. Discount.

Discount earned by prompt payment of bills is a form of interest. Such interest is an earning of capital and can not in any way be used to offset or diminish production cost. Its proper offset is found in any charges for interest on borrowed money which may enable the management to discount accounts and bills payable.

Discounts allowed to customers are another purely commercial cost, which is not under any conditions an offset to

discounts that may be earned or purchased. The fact that a discount given is the reverse of a discount taken does not constitute a valid reason for charging discount items allowed to the customer against a revenue account for discounts earned from supply houses. Yet, strange to say, the practice of entering both charges and credits, of the nature mentioned, in one "Discount" account is common in the public accountant's practice, although to the management or to anyone else the net balance of such an account tells absolutely nothing of value.

Discounts earned may, if desired, be kept in a separate account or be merged in Interest Earned Account. An example of the direct earnings made by discounting purchase invoices is shown in the illustrative account which follows. Here $6,250 has been borrowed for one year for discount purposes at the rate of 6%. This amount enables the discount during the year of $75,000 at 2%. The discount rate—2% at 30 days—is from the interest standpoint abnormal, resulting in a total discount earning of $1,500, while the interest paid for the money which enables these discounts amounts to but $375. The account shows the resulting profit.

DISCOUNTED PURCHASES.

Interest paid @ 6% on $6,250.00	$ 375.00	Discount at 2% on $75,000.00	$1,500.00
Net Earning	1,125.00		
	$1,500.00		$1,500.00

If a concern has sufficient capital on hand for discount purposes, there is then no actual payment of interest for money paid and, usually, no entry on the debit side of the account, the entire interest on capital allowance being entered in a single account of suitable heading.

§ 152. Waste.

Wherever production of goods is undertaken there will be found waste. No matter how perfect the mechanical de-

vice, or how good the production process, or how skilled the operator, waste will occur. Machinery—and even automatic machinery—will occasionally get out of order, or go wrong and spoil production. Processes will fail of their usual results. Employees with the best of intentions will make mistakes or will be careless, with resulting loss of time, material, and machinery.

Such waste is found in every factory regardless of its individual condition of efficiency. Some of it may be wholly or partially eliminated. Other such waste cannot be avoided

In the absence of any better method of disposing of waste or spoiled material, many factories follow the plan of "penalizing" the individual job, by charging it with the cost of goods spoiled on its order number,—a plan absolutely wrong in theory, and in practice resulting in costs that do not reflect the actual conditions. A cost abnormally large because of spoiled work is misleading unless accompanied by an explanation, and even then it stands in the way of cost averages which might be of material value. Mr. Emerson in the following illustration emphasizes the injustice of charging spoiled goods to the order number in connection with which the spoilage occurred:

"A waiter bringing in an expensive dinner to a guest at a hotel stumbles and crashes dinner and dishes to ruin. Shall the guest, besides being put to the annoyance of waiting another half hour, be charged not only double price for his dinner, but also for the broken dishes, or is the expense of the accident to be charged to inefficiency, a general overhead burden on all dining-room operations, taken care of in the standardized cost of each dish, without reference to specific accident?"*

Losses due to spoiled material are properly charged to the "Over, Short and Damage," account (§ 154) with a corresponding credit to the "Goods in Process" accounts—Ma-

* "Efficiency," p. 138.

terial, Labor, and Expense respectively. Without such credits the accounts will show abnormally large balances.

§ 153. Reports of Spoiled or Unused Material.

In Figure 149 is shown a form of report to be used when goods in process are spoiled. This form has already been discussed in § 54. From this report the cost department secures the necessary financial data for its records, and the facts required to relieve the individual shop order of the charges for lost or spoiled material, and transfer them to their proper destination in the "Over, Short and Damage" account. The bottom portion or coupon of the loss report is used for an explanation of the physical causes that led to the loss. This coupon goes to the superintendent, placing the facts before him in concrete form. It can be finally filed under the number of the workman through whom the loss was incurred and will then serve as a part of his efficiency record.

It often happens that delays occur on rush jobs, and sometimes a quick change of orders is necessary in an endeavor to prevent or compensate for lost time. For this also, the same "loss" coupon with "the story of the cause" on it, is invaluable.

When goods are made up in large quantities and the material is issued on requisition, it frequently happens that more material is used than the requisition calls for, in which case a form similar to that shown in Figures 69 and 70 is used to report the condition. This form gives the cost department the necessary data to charge such excess material directly to the Over, Short and Damage Account and to give proper credit to the Stores Account.

§ 154. Over, Short and Damage Account.

To provide an adequate accounting method of properly recording wastage in its various forms, the account "Over, Short and Damage" is employed. This account is debited with the ordinary wastage and spoilage occurring in the process

of manufacturing. It is credited with any values obtained from or on account of the rejected goods, whether by direct sale or through a charge to the individual workman or to "scrap" or "second" or "as is" goods; i. e., goods possibly of high quality, but promiscuously intermingled as to grades and sizes, requiring considerable labor on the part of the purchaser to properly assort.

Sometimes a "company's expense" item bears the debit charge, as in the case of a paper box factory where it is found advantageous to utilize the "waste" boxes of larger size—good as to quality but inaccurate perhaps as to specification—for "packers" for smaller-sized covered boxes. Thus, jewelry boxes are frequently packed for shipment in rejected shoe boxes.

It may be noted in passing that the losses due to variations of weights and measures, though coming in this general category, belong more strictly to the stores division. For this reason the author prefers to reserve the Over, Short and Damage Account for loss on goods in process and finished material, leaving the variations on raw material in stores for the "Variation of Weights and Measures" account. (§ 156).

§ 155. Applying Wastage Costs.

An abnormally large "Over, Short and Damage" loss sometimes occurs. It is logically unfair to burden the cost period in which this abnormal loss occurs with its entire amount, the next period then escaping with a very light burden, lightened still further perhaps by a "salvage" credit passed to the account for the returns from sale of scraps or "rejects" charged in the first period.

To prevent this it is sometimes advisable to establish a reserve against loss by wastage and spoilage. As losses actually occur the items are charged to the reserve account, and, conversely, as any revenues accrue from the sale of scrap or rejects it receives the credit. A proper proportion is

charged to Over, Short and Damage Account each cost period. Theoretically this reserve should "balance," or at least, the debit less the scrap value of rejected goods inventoried should just equal the credit side of the account at the end of the fiscal year. If it does not, then the amount charged each cost period should be properly adjusted by means of a charge or a credit to the "Factor of Safety" account.

§ 156. Variation of Weights and Measures.

Shortages in the store-room are charged to Variation of Weights and Measures Account. With all reasonable care such shortages will occur. In order to anticipate these differences and have each cost period bear a proper proportion of such possible loss, an amount equal to 2% of the total material drawn from stores each period, should be charged to this account and be passed to the credit of a reserve account called "Reserve for Variation of Weights and Measures." As variations are discovered they are debited to this reserve and credited to Stores. Also, in the course of inventorying, where discrepancies are discovered the amount involved may be charged or credited, as the case may be, to this reserve account. The debit to Variation of Weights and Measures is diffused over costs by periodical charges.

§ 157. Factor of Safety.

In manufacturing as in any other business, unforeseen expense discrepancies, losses, or expenditures are constantly arising. To provide for these, a reserve account called "Factor of Safety" is suggested, to which each period a charge of 2% of the total amount of goods in process for the period should be credited, with a corresponding debit to manufacturing expense.

This account, as its name indicates, is purely a safety reserve to cover possibilities. When unforeseen losses occur or unforeseen expenses are incurred, the adjustment may be

made by charging the amount involved to "Reserve for Factor of Safety."

§ 158. Reducing Waste.

It is frequently possible to cut down the losses from "Over, Short and Damage" goods by the use of prizes of fair value or other suitable rewards. Such plans are usually better than a charge to the individual responsible for spoiled goods. If spoiled goods are charged to employees, only a part of the cost is absorbed—usually the cost of material only is charged—overhead expense being left to be borne by the establishment. Moreover, in some states the statutes specifically forbid such deductions from wages.

Where this is the case, the only punishment which can be inflicted for spoilage is the discharge of the employee. If, as is frequently the case, good employees are scarce and hard to find, their discharge involves a hardship on the employer. If wastage is to be minimized under such circumstances, some system of rewards is the only adequate method.

CHAPTER XVII.

DEPARTMENTAL SEGREGATION OF EXPENSE.

§ 159. Methods of Segregation.

The fair and just distribution of manufacturing expense over the various departments affected, is absolutely necessary to an accurate system of cost finding. The best method of distribution is that which minimizes as far as is practical the amount of indirect costs to be diffused on an arbitrary basis,—the method which charges the greatest amount of the so-called "indirect" expense directly to the product to which it really belongs, provided the system is not carried so far as to be in itself top-heavy and economically wasteful.

Under such a system most of the usual overhead expenses become direct and the department and the product to which they properly belong, receive the proper charge; whereas otherwise these expenses must be arbitrarily diffused over all the departments, or when assigned more or less accurately to one department, must be diffused over all the products of that department.

§ 160. Averaging Expense.

It will, of course, be recognized that a broad and general apportionment of manufacturing expense as a whole over the various departments is wrong both in theory and practice. The results, when this is done, do not give information as to the component constituents of cost—one of the most valuable features of a cost-accounting system—and do not even show actual costs.

On the other hand, there is no possible way of entirely avoiding a prorating or averaging of expense. No amount

of detective work economically possible will trace down and definitely place every item. Each expense should, however, be traced down and segregated as far as possible to the process or product to which it applies. When it can be segregated no further, it must then be averaged over the remaining processes or remaining products.

Beyond this there is, of course, in expense apportionment an economically "irreducible minimum" which cannot be definitely allocated even to groups, and this must be distributed as equitably as may be by averages or arbitrary adjustment over the entire output.

When the factory conditions are such that there can be no positive line of demarcation between departments, or if machines in operation are so promiscuously intermingled that departmentizing is a matter of arbitrary adjustment, then presumably the accounting processes will have to adjust themselves to the conditions, and expense be treated in the same arbitrary way. When this is done the accounting results will naturally show a corresponding lack of sharp definition and accuracy.

§ 161. Departmental Distribution of Expense.

Manufacturing expense is first segregated under its various headings. When this is done the amount under each heading is distributed in proper proportion over the departments to which it belongs. This is readily accomplished by means of the distribution sheet shown in Figure 142, ruled with such number of columns as may be necessary for the particular establishment or distribution.

The first column of the distribution sheet shows the totals of the various expense items to be distributed. Each of the other columns is headed with the name of a department of the factory, and as the items of expense are distributed the amount belonging to each department is entered in the column designated for that department. The amounts entered in the

various department columns must, of course, equal the total of the first column, and no permanent entries or applications of the figures of the distribution sheet should be made until the accuracy of the distribution has been proved.

§ 162. Basis of Departmental Segregation of Expense.

The basis of distribution between departments must necessarily differ according to the nature of the expense classification employed. In group C of the chart shown in Figure 1, a list of the usual expense items will be found. This list is general and without specific reference to any given line or class of product. When this list is to be used in any particular factory, specific items of expense peculiar to that factory must be added, or may be substituted for other items in group C having similar characteristics but not found in the particular business.

Items 1 to 6 of group C are for direct charges to departments; i. e., charges arising in such departments and not applying in any way to other departments and therefore needing no further departmental segregation.

§ 163. Rent and Interest Charges.

Rent of factory property is a proper charge to production cost and is distributed over the various departments on the basis of space occupied.

Where the manufacturer stands in the dual relation of landlord and tenant; i. e., is the owner of his plant, a fair charge for interest on the investment should be made—in place of the rent charge that would be made if the property were leased—together with a proper allowance for maintenance, depreciation, taxes, insurance, etc., etc.

It is the practice of perhaps the majority of cost accountants to make such interest charges for investment in plant, though a different view is occasionally taken (see Ch. XII), some accountants holding the charge improper as a manu-

facturing cost and preferring to consider it as a "division of profits" with which manufacturing cost has nothing to do.

The matter is one for the individual in charge to decide, but in any case where a number of manufacturers are endeavoring to get their cost systems on a standardized basis, it is advisable that interest on the investment in real estate and factory buildings at least, be made a part of production costs in order that the concern owning its own plant may be put on the same basis as the concern which pays rent for its land and buildings. It is obvious that without some such compensating charge, the costs of manufacturing in rented property would run unduly high as compared with manufacturing costs in property owned.

Interest, as in the case of rent charges, is distributed over departments on the basis of space occupied. When the factory property is not treated as a unit in regard to land values—i. e., land in different parts of the plant is valued at different prices (see Chapter XIII)—the distribution of interest charges must be made with due consideration for the varying values of the different portions of the property.

§ 164. Engineering Costs.

In factories which have no distinct engineering department, all payments to mechanical and electrical engineers, designers, draftsmen, etc., and all payments for planning, drawing, designing, etc., intended for the developmental and experimental work requisite to the ordinary conduct of the business, are charged as engineering cost.

The work of the engineering department may be divided broadly into three classes as follows:

(1) Work designed to procure certain specific contracts for the factory.
(2) Work done in preparation for orders either in hand or that may be secured.
(3) Work done in fulfillment of specific contracts.

These three classes of engineering work are respectively considered in the three sections which follow.

§ 165. (1) Engineering as a Commercial Cost.

Engineering work designed to secure contracts includes estimates and perhaps designs or blue prints which are furnished the prospective customer. Such work may vary from the design for a lithographed letter-head, up to the plans for a forty-story skyscraper. Such work is purely commercial—a selling expense with absolutely no place in production costs. Its intent is to sell the product or output of the concern and its character is not altered in any way by the fact that such work is commonly done "before the event."

If a contract is secured, the estimate, plan, or design already used in securing this contract may perhaps be again used in its completion. In such case the engineering work takes on a twofold nature. As used to secure the work it is a selling expense. As used to complete the work it is a production cost (see § 167) and the total cost of the plan, design, or estimate must be divided between the two classes of expense. The proportion to be allocated to each is a matter of judgment. The entire amount of such expense is sometimes charged against production cost when the contract is secured—a practice justifiable only when it reflects the facts.

When the estimate or design is not used in subsequent constructive work, it is, as stated, purely a commercial cost and its inclusion in production cost is wrong in both theory and practice, the results being absolutely useless for costing purposes. Entered in selling costs such expenses mean something and give results of value, but entered in production costs they mean nothing and give false and misleading results.

Notwithstanding this condition, there are manufacturers who insist on including such expenses in production cost. If this is done it may be suggested that as *between* depart-

ments the number of productive hours or the number of employees in a department as compared with the total number of productive hours or the total number of employees in the entire plant, does not afford a proper basis for distribution, though *in* a department it may be fair enough to distribute such expense on a man-hour or sold-hour basis.

As profits are usually calculated as a percentage added to cost, so expense of this kind may be segregated to the several departments on the basis of the total cost of all products for the period in that department as compared with the total cost of product for the same period in the entire plant. Or, since in such cases labor is a predominating element, the cost of such expense may, if preferred, be segregated on the basis of pay-roll distribution.

§ 166. (2) Engineering Divided between Commercial and Production Costs.

Engineering work done in preparation of orders either in hand or that may be secured, includes the making of designs, patterns, or samples in anticipation of orders, and also engineering or designing work preparatory to filling orders, as for instance Jaquard cards for weaving new patterns, new shapes of lasts for shoes, dies for advertising novelties, patented articles, etc.

Expenditures of this class belong in varying proportions to production costs and to commercial costs. In some instances such costs may consistently be charged to capital account subject to depreciation, as for instance drawings, dies, forms, etc., which are likely to be of value over a period of years. In some instances the products of such costs have a value as saleable commodities, as for instance, sample shoes, rugs, and sample wares of other kinds. Lasts, cutting forms, and other related utilities frequently have a rapidly wasting value, and in such case, while they can be charged to capital at the beginning of the year or season, they should be gradually absorbed in production costs during the year.

The loss or diminution of value involved in the manufacture or use of goods for samples is of a purely commercial nature, properly chargeable to loss and gain accounts, and not to production costs.

§ 167. (3) Engineering as a Production Cost.

Engineering work in fulfillment of particular contracts comes clearly under the general classification of manufacturing expense. It includes detailed drawings, designs, specifications, etc., etc., for the use of the particular concern on specific jobs. It also frequently includes the cost of inspection or supervision of particular jobs or contracts.

Expenses of this character are a direct charge to production costs and moreover are easily charged to the proper individual production order numbers. As to this class of work, the engineering department can be considered on the same plane as a direct producing department and therefore its product, instead of being segregated over other direct producing departments, can become a direct charge to goods in process. When this is done, the individual items go to the proper individual order numbers, and the aggregate goes to the controlling account "Process" (goods in one department which have come there after undergoing the operations of another department) in the next succeeding department which makes use of such drawings, designs, or specifications.

"Process" is charged in this case rather than the controlling expense account of the succeeding department for the reason that the latter charge would tend to unduly enlarge the expense account and therefore apparently reflect more or less exaggerated costs for that department—costs in which its foreman has no voice. The charge to expense in a succeeding department should only be followed when there is no means of allocating engineering costs to specific orders and it becomes necessary to diffuse them.

There are cases where the services of the engineering department on successive production orders in process are so

nearly alike in average quantity and value that it may seem unnecessary to find the specific costs in each and every case. Thus, wagon and automobile springs are usually made on an avoirdupois pound basis; hence, it may be a matter of more importance to learn the engineering cost per average pound of the product in the cost period, rather than a specific cost applied to a certain job the compensation for which, after all, is calculated on a pound basis.

Where experimental work is properly chargeable to production costs, it may be distributed on the basis of the number of direct producing hours in each department as compared with the total number of direct producing hours in all departments.

§ 168. Rules for Distribution of Engineering Costs.

The conditions surrounding engineering work are such that no hard and fast rules can be laid down for the distribution of its costs when these are applicable to production. The local conditions and the plan of cost finding must be considered. The following rules are general:

(a) Services of a special engineering nature, when the time involved is determined by the needs of the individual case, may be charged to order numbers on the "specific cost" plan.

(b) Services of a more or less general nature, the time of which can be fairly equalized between the various orders in process to which they apply, either with or without reference to the quantities involved, may be handled on the "list-percentage" or the "sold-hour" plan with the possibility of "specific costs" in addition when so desired.

(c) Services of a more or less general nature where the time applied to various orders in process can be better calculated on the basis of the unit rather than that of quantity involved in the order, may be handled on the "list-percentage" plan with the possibility of specific costs in addition when so desired.

§ 169. Patterns.

The treatment of patterns is much akin to that of the production work of the engineering department. In some cases the cost of patterns can be charged to customers benefited therefrom and does not then appear in production costs at all, and again in some cases patterns are capitalized and their repairs charged to a maintenance account.

Inasmuch as patterns (wooden) are a wasting asset in both the physical and commercial sense, many conservative manufacturers prefer to immediately absorb their cost into current product on the basis of a direct charge to foundry cost; or equally to all departments contributing any direct productive labor to product made in whole or in part from patterns; or on the basis of the number of productive hours in each of the various departments contributing to the work made with the use of patterns as compared to the total number of productive hours of all departments contributing to such work.

§ 170. Purchasing Department.

The costs of the purchasing department are a proper charge to manufacturing expense. Speaking broadly, the purchasing department is never a direct producing department. It is entirely subsidiary to the departments it serves, and its costs are to be equitably allocated among them—a process sometimes of considerable difficulty.

The first feature to be considered in determining the measure of usefulness of this department to the producing departments is the amount of material and supplies consumed by each of them. The question is immediately raised—Shall the amount be considered in a financial or a physical sense?

It is obvious that neither affords a satisfactory basis for the distribution of purchase costs. The skill, time, and trouble expended by the purchasing department in any particular case are measured neither by the value nor avoirdupois of the

material or article purchased. Practically it is impossible to arrive at any satisfactory basis of adjustment. Perhaps all things considered, the best that can be done is an arbitrary department charge, or a charge on the basis of an average of prices and weights of commodities issued to each department during the current cost period. This latter plan takes cognizance of bulk as well as value, and the law of averages must be depended upon for a fair final result.

It may perhaps seem a more logical plan for the purchasing department to keep time records of all work done in the purchase of material and supplies for the different departments. Theoretically this may be correct, but in practice the duties of purchasing department employees are so numerous and varied and so difficult of just distribution over materials purchased, as to make such a plan generally impractical. In individual cases it may perhaps be used to advantage but it certainly is not feasible as a rule.

§ 171. Stores Department.

The difficulties of properly distributing expenses in the stores department are similar to those found in the distribution of purchasing department costs, with the additional features of freight, expressage, and hauling on inbound material to be considered.

In the handling of stores, bulk or weight seems to be the more logical basis for expense charges. On the other hand, a pound of wood screws may cost as much for storage and care as do twenty-five pounds of iron castings. A basis of expense charge founded on both bulk and cost would perhaps be the fairest method of apportioning charges.

In theory, inbound carrying charges should be added to the purchase cost of the incoming material. Under the list-percentage plan of distributing costs this is perhaps practical. Under the specific cost plan the clerical labor involved is ordinarily so excessive as to be almost prohibitive.

When inbound carrying charges are not added to stores costs direct, then "Freight, Express and Drayage" items can be charged to the stores department account and be eventually absorbed by the various producing departments.

It is not only possible but under certain conditions desirable to apply the larger items of incoming carrying charges direct to the cost of the material brought in, while the smaller items are diffused. Under this plan special care must be taken to see that the department and the individual order number which uses the freight-burdened material, do not get an over-application of freight costs.

§ 172. Plant Management.

The activities of the plant manager and superintendent, and of their respective office forces, belong almost entirely to the production department, and have little if anything to do with commercial costs. The pay roll is occasionally used as a basis for distributing the cost of plant management over the various departments. The plan is faulty as the amount paid in wages in the several departments has little or no connection with the cost of supervision. The bases of allocation most frequently employed in the distribution of management charges are:

(a) The number of employees in each of the several departments.

This plan proceeds on the assumption that the attention of the plant managers and their assistants is given to each department in proportion to the number of employees therein.

(b) The importance or value of the product of each individual department as compared with the value of the product of the plant as a whole.

This plan assumes that official attention will be directed more largely to those departments which contribute material and workmanship of peculiar characteristics and therefore of peculiar importance or value. The distribution of plant man-

agement cost on this basis is arrived at arbitrarily after a careful consideration of the facts involved. Such distribution should be checked by occasional tests extended over a week at a time, both the officials and their clerks recording time spent on work which can be allocated to one or another of the departments.

(c) The amount of supervisory attention given to the respective foremen.

This plan proceeds on the assumption that official attention will be most largely directed to those departments in which intricacies and possibility of congestion are most liable to occur. The segregation of costs under this plan, as under the preceding plan, is an arbitrary apportionment arrived at after a careful consideration of the facts involved. Occasional tests will prove its approximate accuracy.

It sometimes happens that clerks in the executive office have duties of such a nature as to bring the segregation of their cost within the scope of some other plan than here outlined. In such case the cost of their services is, of course, distributed on the proper plan independently of the rest of the executive office.

§ 173. Administrative Costs a Pro Rata Expense.

No business can succeed without an executive organization, and the measure of its success is largely determined by the ability of its executive force. The costs of this executive organization come under the head of pro rata expense; i. e., items of cost which enter into both the manufacturing and commercial ends of the business. At times the administrative costs belonging to the two classes are readily differentiated and when this is the case the accounts capable of this closer classification may be eliminated from the pro rata group.

Local conditions must govern the division of administrative expense as between manufacturing and selling. Where the factory plant is entirely separated from the general office

or commercial headquarters, and the concern maintains a factory office with its own separate organization, then the prorating operation is a clean-cut one. Where the business is largely run from one general office the division is not so simple and is to be determined by good judgment and local conditions. As a rule, the larger part of executive costs are commercial and not properly chargeable to production costs.

§ 174. Departmental Distribution of Administrative Costs.

Executive costs which properly belong to production are spread over departments on the basis of the direct-producing hours in each department as compared with the total of direct-producing hours in the plant.

Where different manufacturing concerns are establishing a common standard of cost charges, and desire to standardize their purely executive expenses—not including work of a semi-clerical nature, the value of which may be measured by ordinary standards—a charge of 2% of the product is suggested. Thus, if one of the factories has an output of a cost value of $500,000, 2% is to be added to this for executive expense, bringing the total cost of product up to $510,000.

The cost of the cost department itself is properly chargeable to production and is distributed on the basis of productive hours in the several departments as compared with the total number of productive hours in the entire plant.

§ 175. Maintenance and Depreciation.

Maintenance cost, either when treated directly or handled through a reserve account, is spread over departments on the basis of the money invested in each in the property to be maintained.

In segregating depreciation over departments, the same general principles apply as in other forms of expense. As far as possible the depreciation occurring in each department must be charged to that department. The remaining depre-

ciation, which cannot be thus equitably diffused, is to be prorated over the whole plant, as more fully set forth in § 116, "Maintenance and Depreciation Charges."

§ 176. Power Plant.

When power is purchased, its cost is distributed equitably on the basis of horse-power used by each department. When power is generated the power plant is preferably treated as a separate and distinct department, to be diffused as a whole by horse-power units, as set forth in Chapter XV.

When the power factor is not considered as a unit, and the cost of engineers, stokers, fuel, and other accessories of the power house are treated separately, an apportionment should be made in each case for every department affected.

Regardless of whether the power factor is treated as a unit or not, the following factors of production cost should be independently segregated over departments:

(a) Heat to be spread over departments on a basis of radiation.

(b) Electric current for lights or power to be spread over departments on a basis of current used, as described in Chapter XV.

(c) Compressed air to be spread over departments either on an arbitrary basis or preferably through means of tests, as described in Chapter XV.

Where the power unit is not determined, the power-house expense, after deducting the foregoing distribution, may be spread over departments on a basis of horse-power needed and used by each. Fuel may be treated on the same basis, as also any other analogous power charges.

Fuel is, however, to be excepted from this general statement when it is used for purposes other than generating steam. (See § 178).

Where gas or oil is used as a power fuel, it will, of course, take its place in the cost of the power unit just as in the case of coal.

In cases where live steam is not only used for power, but for boiling water, heating dry houses, etc., a division of steam generating costs should be made before any portion is applied to power costs in any form.

§ 177. Power Included in Rent Charge.

Where space in a "power building" is rented for manufacturing purposes and power is furnished without additional charge, or wherever power is included in rent charges, the two items of rent and power must by some equitable means be separated so that each of these cost factors may receive its proper distribution.

In some cases the division is unavoidably arbitrary. Sometimes the landlord is willing to assist by a statement of his power costs. Not infrequently, however, the landlord is himself unable to make any intelligible statement of costs and the accounting department must then make its own calculations.

Where this is the case, either the cost of power may be based on charges for power in nearby plants where power is purchased, or the rent may be based on the square foot rental rate without power in nearby buildings of a similar character. After either power cost or rental cost is determined, the determination of the other cost factor is a mere matter of subtraction. In the case of rent the departmental distribution will be on the basis of floor space and in the case of power on the horse-power used by the department.

§ 178. Fuel Other Than for Power.

Coal. When coal is used for forges or for purposes not immediately connected with the generation of power, it has no connection for costing purposes with coal used for power purposes, and the two should not be intermingled in a common account. The cost of coal not used for power purposes must be divided among the departments on a basis of fuel used, determined either by occasional tests of actual fuel

consumption, or by the use of containers of known dimensions.

Natural Gas. Where natural gas is used as fuel in smelting furnaces, forges, or other places, local conditions must govern the distribution of its cost. In some cases gas is supplied at a flat rate. Under such circumstances meters are not usually installed, and an equitable division of the cost of gas will have to be based on estimates of the proportionate use of the various departments, or the division be made on such other basis as seems to give the most accurate results. Where meters are used the matter is, of course, simple, each department being charged with the amount of gas actually consumed.

Fuel Oil. Where oil is used for fuel it should properly carry with it handling charges as well as the cost of the crude oil. The cost of operating storage tanks, pumps, pipe lines, and special containers is properly added to the price of the oil itself, the total cost being distributed over departments according to the amount of oil used by each.

§ 179. Light and Water.

If gas or electric current is purchased from independent sources for light purposes, the charge is, of course, specific, and spread over departments on a basis of benefits derived. This is best arrived at by meter readings, or if separate meters for the various departments are not installed, it may be arrived at with fair accuracy by a consideration of the number of burners or lamps in each department and the length of time these are in service.

In cases where the factory generates its own electric current the cost of lighting, as accurately as can be ascertained, will be separated from that of power and spread over the various departments as in the case of current purchased. Where power costs are not found as a unit, the charge for light must come through an equitable pro rata distribution of the cost of fuel, engineers' and firemen's wages, etc.

Where water is purchased, its cost is diffused over the

departments by meter readings on the basis of benefits received. Where the plant has its own water supply, the cost of pumping, maintenance of water plant, etc., is charged over departments, preferably on the basis of meter readings, or if meters are not installed, on the basis of benefits received as nearly as can be ascertained.

§ 180. Supplies. Oil and Waste.

Where the quantities are large, supplies of this nature should be issued to individual departments by requisition in order to prevent extravagance. When this is done each department is, of course, charged with the amount actually used. When the quantities are not sufficient to justify this, periodical tests may be made to ascertain the proportionate quantities consumed by the various departments, and the result of these tests be used as a basis for distribution of the total cost. It may be said in passing that in some plants no restrictions are placed upon the use of lubricating oil, the management preferring to bear the expense of a possibly extravagant use rather than to run the risk of hot and worn bearings due to an insufficient oil supply.

§ 181. General Factory Supplies.

These consist of such articles or materials used about the plant as do not enter into the product as a part of the material element. Files, hacksaw blades, drills, brooms, towels, and soap are examples of charges of this kind. Wherever possible these items should be drawn from the store-room by requisition and such requisitions be charged directly to the department benefiting. Where a requisition system is not in use, or where for any other reason such costs cannot be positively allocated, a more general distribution is necessary, best perhaps on the basis of the employees in each department, as compared with the total number of employees in the plant.

§ 182. Miscellaneous Services and Expenses.

Association Costs. These are distributed on the basis of the number of employees in each department as compared with the total number of employees in plant.

Inspectors. Where not directly chargeable to specific departments, inspection cost may be divided between the departments benefited, either arbitrarily or on such other basis as local conditions may suggest.

Tool-making and Repairing. Where not chargeable directly to departments costs of this nature may be distributed on the basis of the number and character of machines in each of the machinery departments.

Carpenters and Painters. Where used on product in a general way but not directly applied to individual orders, nor yet to specific departments, or where for other reasons it cannot be allocated directly, this cost may be arbitrarily divided between the departments benefited, or be distributed on such other basis as local conditions may suggest. Presumably a portion of this cost applies to repairs and will be distributed under maintenance.

Millwrights. Where not directly applied to individual orders, this cost can be absorbed on the basis of average service rendered, as determined by records and occasional tests.

Porters and Messengers. Distribute this cost on the basis of (a) nature of service between certain individual departments, or (b) number of employees in each department as compared with the total number of employees in the entire plant, or (c) an equal division between the departments benefited.

Truckmen and Elevator-men. When not readily applied to specific departments, the cost of this service can be spread over each department more or less directly benefited, on the basis of the number of its direct-producing hours, as compared with the total number of direct-production hours in all departments benefited.

§ 183. Taxes and Insurance.

These costs are to be distributed on the basis of the amounts invested in the various departments. By the amount invested is meant not only the amount invested in buildings, machinery, and equipment, but also the average amount involved in the volume of product passing through the particular department.

Where the plant is treated as a separate factor, as discussed in Chapter XIII, taxes and insurance are absorbed in the general plant charge and are distributed in combination.

Where taxes are charged directly to cost, the most equitable method of diffusion is to charge each current month or period with its pro rata proportion of the estimated annual amount of the tax. When actual payment of these taxes is made, such payment is charged against the reserve account to which the pro rata debits to cost were credited.

Insurance being usually paid for in advance, is just the reverse of a reserve and its amount is entered in a suspense account and carried as a negative asset. Then, as the month or cost period is passed, the "earned premium" is charged into costs and is credited to the Insurance Suspense Account.

§ 184. Technical Library.

This may include both bound volumes and current periodicals. In some cases the cost of the library may be treated as an asset, but the better plan is to absorb its cost in overhead expense as time proceeds. Where the library is maintained for any or all of the employees indiscriminately—as is very generally the practice in modern institutions—the cost may be spread over departments on the basis of the number of employees in each, as compared with the total number of employees in the plant.

The propriety of debiting production costs with the expenses attached to a technical library is hardly open to question. The importance of such a library cannot be emphasized

too strongly, not only for its direct technical value, but also for its general effect on the men and the indirect effect on production; i. e., the new ideas more or less directly developed from its use which inure to the benefit of processes and production.

Technical libraries are becoming more and more a feature of the modern plant, and the investment in such a library is apt to produce greater returns, direct and indirect, than almost any other investment of equal amount in the plant.

§ 185. Safety Reservations.

The Over, Short and Damage Account (§ 154) may be established either departmentally or for the factory as a whole, as may seem best in the individual case. If established with the department as the unit, this in itself gives departmental segregation. When the unit is the entire plant, and a reserve account is maintained in anticipation of over, short and damage losses, then such reservation can be charged to departments on the basis of the number of productive employees in each department, divided into the total cost of goods (liable to damage) passing through the department in a given period. This gives the average value of goods per productive employee. A total is made of these averages and the percentage the average of each department is of the total average, gives a basis for distribution of losses of this nature.

When the account "Variation of Weights and Measures" (§ 156) is kept, and an amount equal to 2% of the total material drawn from stores each period is charged to it and passed to the credit of a reserve account called "Reserve for Variation of Weights and Measures," this 2% reserve will be distributed each cost period on the basis of the average value of material and supplies used by the various and several departments as compared with the entire purchases for the period.

When a "Factor of Safety" account (§ 157) is maintained, its reserve may be distributed over departments on a

basis of the amount of expense charged to each department as compared with the total expense.

§ 186. Miscellaneous Manufacturing Expense.

This is one of those general accounts which are so often abused and utilized as dumps for inefficiency or indifference, and which therefore need frequent and careful scrutiny. The cost of miscellaneous manufacturing expense can be absorbed on a basis of (a) the net amount of other expense charged to each department as compared with the total expense for the period, or (b) the number of employees in each department as compared to the total number of employees in the plant.

CHAPTER XVIII.

SPECIFIC PLANS FOR DISTRIBUTION OF EXPENSE OVER PRODUCT.

§ 187. Diffusion of Expense over Product.

The departmental segregation of expense is practically the same in any plan of accurate cost finding. When, however, we come to the direct diffusion of expense over product, we find sharply divergent methods. The selection of the particular method will depend to some extent upon physical conditions in the plant and upon the plan of labor records maintained.

As already stated there are in common use five methods of diffusing expense over product. The characteristics and the advantages and disadvantages of each are more fully considered in the present chapter.

§ 188. The Percentage Plan of Distributing Expense.

Under the percentage plan, the labor cost or labor and material cost of each job is ascertained and a certain percentage is added thereto for expense burden. This percentage of expense is either estimated or determined from the records of past performance.

Under simple conditions where the processes and products are fairly uniform in character, the loading of expense burden on the basis of direct production labor costs is reasonably accurate, but as conditions become more complex the method loses such accuracy as it had until finally it cannot be safely employed.

Thus if the productive labor cost of a given department amounts to $6,000 per month, and the direct manufacturing

expense, together with the segregation of overhead costs for that department, amounts to $3,000 in the same period, it is clear that the burden to be diffused is 50% of the direct labor. Also if the expense is diffused on this basis, the results in the case of a single shop or a department with machines all of a similar kind, approximately of the same size, performing practically identical operations, and employing operatives of a fairly well averaged rate of compensation, are not very far from correct.

When, however, such a method is applied to a shop or department in which large and small machines, cheap and highly paid labor, heavy castings and small integrants, are all simultaneously involved, the method is no longer trustworthy. On the contrary, it is absolutely unscientific and unsafe.

The reason for this is found in the varying nature of the charges involved which cannot properly be taken in bulk and diffused over product equitably on the basis of labor cost. Thus, the expense burden must take cognizance of the interest factor, the varying space occupied by different machines, the varying volume of power required to drive these machines, the varying rates of depreciation, the variations of labor efficiency, of supervisory requirements, etc., etc., which bear no direct relation to the cost of labor. The cost of labor is then an absolutely arbitrary basis of distribution, bearing no necessary relation to the expense burden of product, and selected as a basis of distribution only because it is convenient. The weight of the product might be taken as the basis of expense distribution with equal logic, and on a simple, unvarying product where expenses run with reasonable uniformity, weight would work as well as would labor cost. There is no reason for selecting either.

The following quotation gives a good general view of the diffusion of indirect expense on the basis of direct labor cost:

"By reason of its simplicity, this method of distributing indirect expenses is in more general use than any other. The principle upon which it is based is that the product increases in value according to the amount of labor added to it, and that the greater the amount of labor involved in the manufacture, the greater the expense required to supervise this labor and conduct the business.

"This, considered as a general principle, is true within the limits of its operation, but it is seriously questionable whether it covers the whole field. There are many other factors in production besides labor, and these are frequently of such prominence that they dominate or characterize the situation. * * *

"Let us assume that there are several departments in a factory which differ among themselves in process and equipment. It is almost certain that there are indirect expenses peculiar to some of these departments which bear no relation to any of the other departments. Let us further assume that the product manufactured embraces a number of articles, some of which pass through all departments and others through certain departments only. It is quite clear that, if the per cent. of indirect expense is ascertained in each of these departments separately, some would show a considerably larger rate than others. Consequently, if an average rate is used for the entire plant, instead of a separate rate for each department, some articles will be charged with an excessive amount, while others will not receive their due share of the indirect expenses actually incurred in their manufacture. * * *

"Suppose a manufacturer finds that he cannot meet competition on certain articles without reducing the cost of their manufacture, or else paying a loss out of the profit derived from the production and sale of other articles. * * * It might be supposed that the proper thing to do is to lower the labor cost by cutting wages or hiring cheaper workmen, for by so doing he not only saves the difference in wages,

but the cost of these articles will be burdened with a smaller part of the indirect expenses. But it would be absurd to act on such a suggestion, since lowering the wages of the men has not the slightest influence on the true indirect expenses, and the hiring of cheaper workmen would, in all probability, only serve to make them greater at the very point where they would be shown to have decreased.

"It is distinctly apparent that there must be something vitally wrong with such a system of figuring costs. As before stated, the trouble lies in the average rate, which makes it necessary to overcharge some articles and undercharge others. * * *

"While it has been shown that accurate results can be obtained in but few cases where an average rate of distribution over the plant as a whole is used, it must be kept in mind that if this method of distribution is calculated departmentally, the objections that have been strongly emphasized very often disappear, and the results would be all that could be desired."*

§ 189. Percentage Plan as Affected by Variations of Labor Cost.

If the percentage plan is employed, to be most effective it should be based on the four-week or monthly cost period, and not on long time averages. Before the advent of the more scientifically devised cost systems of the present day, when the percentage plan was used—because nothing better was known—the usual plan was to determine costs annually, the percentage of expense burden being derived by comparison between the figures representing expense and those representing labor, or labor and material combined for the preceding year. Such long drawn averages cannot be safely relied upon.

As a broad example of how little labor cost can be depended on as an equitable basis of loading overhead burden,

* Nicholson, "Factory Organization and Costs," pp. 41-44.

unless taken for short periods and under carefully watched conditions, the case of a top-hand working alongside an apprentice or "cub" may be cited. The latter's skill has perchance come to equal that of the top-hand and on certain kinds of work he can turn out as large a volume as the former. Yet there is a wide difference in wage rates, and as a result on a percentage basis the top-hand's work is loaded with a much heavier burden of expense than is the apprentice's. In the following illustration of this variation, the wage of the top-hand is assumed to be twice that of the "cub." In the third column are shown the results if an average wage be taken as the basis in finding the prime cost.

	Top Hand	Apprentice	Average Wage
Time consumed	5 hours	5 hours	5 hours
Units of product	100	100	100
Material cost	$1.00	$1.00	$1.00
Labor cost	1.20	.60	.90
Prime cost	$2.20	$1.60	$1.90
Expense burden (50% of labor cost)	.60	.30	.45
Total production cost	$2.80	$1.90	$2.35
Cost per unit	.028	.019	.0235

§ 190. Percentage Plan as Affected by Variation of Production Speed.

Again, in the case of two machines of like character but of different speeds, the one turning out twice as great a volume of product as does the other, we will find an equal uncertainty in the diffusion of expense burden under the percentage plan. Thus if the operator of the high-speed machine receives twice the wage paid the operator of the low-speed machine, it will be seen that the expense burden per unit estimated as a percentage of labor cost, is the same in either case.

This is obviously incorrect. High production means low burden and low production means high burden. The facts demonstrated by practical experience show that while the fast machine requires more power, it does not require twice

as much, nor is the wear and tear of the rapidly moving machine twice as great as on the slower moving machine. These factors are the only ones disturbed by the increase of speed. The cost of space, supervision, interest on investment, and all of the other items of overhead burden remain the same. The amount of expense burden per production unit of the fast machine should then be materially lower than that of the slow machine.

The following illustration shows the inequitable distribution of expense burden under the circumstances. The first column shows the expense burden on the product of the slow machine; the second column shows the expense burden on the product of the high-speed machine when the wage paid its operator is twice that paid the operator of the slow machine; the third column shows the expense burden on the output of the rapid machine when one-third more wage is paid its operator than is paid the operator of the slow machine.

	Slow Machine. Hourly Wage 15c	Rapid Machine. Hourly Wage 30c	Rapid Machine. Hourly Wage 20c
Time consumed	5 hours	5 hours	5 hours
Units of product	50	100	100
Material cost	$5.00	$10.00	$10.00
Labor cost	.75	1.50	1.00
Prime cost	$5.75	$11.50	$11.00
Expense burden (50% of labor cost)	.37	.75	.50
Total production cost	$6.12	$12.25	$11.50
Average per unit	.1224	.1225	.115

If the labor cost for the fast machine were identical with that of the slow machine, the burden of expense would be the same in either case, which is obviously incorrect, since the output of the faster machine must stand the added expense of both increased power consumption and increased wear and tear.

It is apparent that there is a point at which wages could be fixed where the expense burden would be properly distributed, but it is equally apparent that any system of expense

diffusion that requires a wage adjustment in each case for a proper distribution of expense, is fundamentally and fatally defective.

§ 191. Percentage Plan Based on Material Cost.

The cost of material bears even less relation to expense than does the cost of labor. Rent, heat, light, power, telephone service, non-productive labor, executive salaries, etc., etc., are usually not affected in any way by the cost of the material which must bear the burden of such expense.

As a good example of the fallacy of distributing expense on the basis of material the case of two journeymen manufacturing jewelry may be cited, both of whom were working under precisely the same conditions, in the same environment and on the same pattern; yet one was making a sunburst of gold set with diamonds, while the second was making a sunburst of cheap yellow metal set with rhinestones. This is an extreme case but one which actually occurred through the taking on of special work out of the manufacturer's regular line of product.

Under such circumstances the burden of expense should be precisely the same for both products, but, if diffused on the basis of material, the first job would have an enormous burden of overhead expense while the second one would have a very small one. The following illustration shows the inequality of such a distribution.

	a	b
Time consumed	20 hours	20 hours
Units of product	1	1
Material cost	$1,000.00	$10.00
Labor cost	8.00	8.00
Prime cost	$1,008.00	$18.00
Expense burden (5% of material cost)	50.00	.50
Total production cost	$1,058.00	$18.50

Inasmuch as there is no real relation between the cost of material which goes into product and the expense burden

which that product should bear, the employment of the plan sometimes brings about absurd conditions. Thus, if unusually high-priced material is loaded with the usual percentage of expense burden, it absorbs costs that do not exist and which were not incurred. On the other hand, exceptionally low-priced material does not bear its proportion of the expense burden that actually exists and which it properly incurred. Of course, the overcharge on high-priced material might offset the undercharge on low-priced material, resulting in a fair average cost, but even if this happened to be the case, a fair average cost is not what is wanted, nor is a possible balancing of errors a safe basis for even an average cost.

The only argument in favor of the percentage plan is its comparative simplicity in operation. Where the product is uniform, processes unvarying, costs not liable to change, and the conditions surrounding processes and output devoid of disturbing influences, it may perhaps be used to advantage. It is not, however, to be commended even under these favorable conditions.

§ 192. The Man-Hour Plan.

Under this plan the total number of direct-productive hours of labor in each department for each month or cost period, is divided into the total amount of the manufacturing expense in that department for the same period, thereby arriving at a constant per productive hour in each department. Each shop order in process can then, in each successive department, be loaded with an amount of overhead expense or burden, equal to the number of productive hours it has consumed, multiplied by the departmental constant. This differs from the percentage plan in taking the hours of labor instead of the cost of labor as the basis for distribution of expense. Under the man-hour system the cost of labor—from the standpoint of expense distribution—is of no importance. In other words,

the man-hour charge is a time charge without relation to labor cost.

The man-hour plan of distributing manufacturing expense is much more logical, more generally available, and more accurate than is the percentage plan. Each employee in a factory, whether man, woman, or child, requires the same amount of attention in a general way as does the next one. Each employee must have his place on the pay roll, time reports to be accounted for, a peg or locker for his clothing, toilet facilities, soap, towels, wash water, drinking water, casualty insurance, etc., etc., and it costs no more in one case than in another, no matter what the difference in wage rates may be. Also, for all practical purposes each employee takes up an equal amount of factory space physically, and, if he be a slow worker, is narrowing the possible volume of output of product of his department even though he be a low-priced man.

By applying a cost per hour for burden, the "on-cost" is, as stated, in effect a time charge—a toll charge for the benefit accruing from the use of the department's conveniences, based, as in the case of the long-distance telephone, on the length of time these conveniences are used and not on the amount of money involved in the operation,—or in the case of the telephone, in the conversation. The labor hours by which this time is measured is merely a convenient way of arriving at the time the particular job is "on the line."

Where the man-hour plan of distribution is to be employed it should, by all means, be used independently in each individual department. A man-hour constant taken for the factory as a whole is absolutely valueless as far as accurate cost finding is concerned.

The logical time for spreading costs by the man-hour plan and the necessary time for exact results is at the close of the month or the cost period. It occasionally happens, however, that production costs are desired before the close of the cost period and then some slight element of guesswork

must enter into the calculation, even though in a going institution the man-hour rate should at all times be maintained at a fairly close mean average.

As a matter of fact, many shops within the author's knowledge obtain the man-hour constant but four times a year, and secure fairly accurate results, especially where the line of product is unvarying.

§ 193. Variation of Expense Rate under the Man-Hour Plan.

Under the man-hour plan the expense constant is from time to time liable to small variations due to different causes incident to the business, as, for instance, seasonal conditions which influence the volume of output, etc., etc. Where such fluctuations are anticipated, the constant may still be maintained at a fairly even figure by charging production in the period of lower costs with an amount estimated to be sufficient to balance these fluctuations. This amount is credited to a reserve account and is absorbed during the season of higher costs.

At first sight this may seem wrong in theory, and it does involve a certain averaging of costs, but this is done "with knowledge and intent" and under such conditions that errors can be corrected. In practice the record of costs may be worked down under this plan to a very fine point, any errors of estimate being corrected as shown by the facts. For instance, during the course of a low cost period, perhaps $.025 per hour will be loaded for reserve against another season and at the close of this other season it is found that only $.017 was necessary. In such case, under the man-hour plan the correction can be worked out on a given shop order without difficulty. Under the percentage plan of spreading expense burden, such a matter would be absolutely impossible of satisfactory adjustment.

Where no cognizance is taken of variation by seasons, the record of costs of a given unit of product as shown by the

successive shop orders under which such unit of product is made, will frequently vary materially. In such case some explanation of the cause should be entered on the shop order itself.

Where departments are at times run at less than full capacity, or even stopped temporarily, there is always a loss involved and such loss must be absorbed by product in one way or another—preferably, as in the case of seasonal variations, through the medium of a reserve account. One way is to charge idle time into a reserve account under a suitable title, this title being selected on the hypothesis that the idle time was due to some anticipated and well-defined cause worthy of statistical reference, which must be so recorded that it may subsequently be traced, if need be, through the record of costs of product.

Another, but not a good way under the man-hour plan is to omit the reserve and in determining the constant to consider only the actual hours applied to product during the period of slack time. This, as will readily be seen, is bound to cause a very high constant per actual productive hour and need many explanations as reference is subsequently made to the cost records.

The *modus operandi* of spreading expense on the man-hour basis is simple. By reference to the cost records, the order numbers and the total number of productive hours under each order in process may be ascertained and be listed on a sheet prepared for the purpose, a wide-carriage adding machine being used. One department at a time is listed and the operator must make sure that the departmental total of hours thus obtained agrees with the number of hours appearing on the pay rolls for such department.

When this is done, the sheet is removed from the machine and the extensions made for each departmental order number by multiplying the number of hours, by the departmental constant. The extensions thus made are added and

the total should exactly equal the total expense of the particular department for the period under consideration. The sheet on which this record is worked out should be preserved in a binder for possible future checking purposes or other reference. Where the volume of work is not sufficiently large to warrant the use of an adding machine for the purpose, a form similar to that shown in Figure 143 can be used for diffusing the burden over the various orders, entries being made with pen and ink.

§ 194. Distribution of Expense under the Sold-Hour Plan.

The method of absorbing the expense element under the sold-hour plan of cost finding is, to all intents and purposes, similar to that of the man-hour plan. The only practical difference is in the method of applying the expense constant. Under the man-hour plan the actual pay-roll cost of the direct producing labor is charged directly to the individual job order numbers to the exact extent of time occupied by workmen on such orders. When this is done the expense constant is added to the cost of the job on the basis of the number of productive hours the work has been in process.

The sold-hour plan, on the other hand, contemplates averaging all direct-producing labor costs in each department and arriving at a departmental flat cost per hour, called the "pay-roll hour," to which is added the constant of expense as described under the man-hour plan, thus arriving at the cost of the sold hour in that department. The charges to product are then the cost of material and the cost of the number of sold hours consumed, with a margin of profit arbitrarily added.

This plan of absorbing the expense constant through the medium of the labor cost is thought by some to be more simple in operation than is the man-hour plan, and possibly it is, where the averaged hour can be used, but it would be cumbersome to apply in any system of costs where hours of many varying labor values are employed. The distribution

of expenses under the sold-hour plan will be found more fully treated in Chapter XX.

§ 195. Distribution of Expense under the List-Percentage Plan.

The method of absorbing the expense element under the list-percentage plan varies materially from that of the percentage plan. Instead of a general or fixed percentage upon the value of either of the constituent physical elements, material and labor, the expense burden is expressed as a percentage—determined by tests, or estimates, or by reference to records of past production—of the list price of the different articles of product involved.

The list-percentage plan involves another feature not characteristic of the ordinary percentage plan; i. e., a sharp supervision is kept over the variations for the cost period of the debits and credits to each departmental expense account, with occasional adjustments as needed to allow for and minimize the effect of such variations. Also specific tests are made from time to time to the end that the constituent element of cost of each article of product may be kept at a fairly correct percentage of its list price.

The distribution of expense under the list-percentage plan is more fully treated in Chapter XXI.

§ 196. Distribution of Expense under the Machine-Hour Plan.

The characteristic feature of the distribution of expense under the machine-hour plan is the practical elimination of the ordinary indirect expense. Every expense is traced down as far as possible and applied directly to product through a gross hourly charge for the machine service. The method somewhat resembles that of the man-hour plan but goes much further into detail, using the individual machine or groups of machines, as the unit for distribution of expense, instead of the department as under the man-hour plan.

A comparison of the machine-hour plan with the man-hour plan reveals about the same difference in refinement of application as would obtain between a man-hour plan based on departmental costs and the man-hour plan based on the factory as a whole.

Without doubt, where it can be used, the modern machine-hour plan is the most scientific and accurate of all methods of diffusing overhead costs or burden over products. The method is comparatively simple in operation when once properly installed, but on account of the very fine application of costs, its installation is a matter of difficulty, requiring a thorough knowledge of the principles involved and of their proper application.

The method of expense diffusion under the machine-hour plan is treated at length in Chapters XXII to XXVII of the present volume.

PART V.—COST-FINDING PLANS.

CHAPTER XIX.

ESTIMATE AND TEST PLAN. THE SPECIFIC PLAN.

Estimate and Test Plan of Cost Finding.

§ 197. Characteristic Features.

The estimate and test plan of cost finding, if it may be considered as having risen to the dignity of a well-defined plan, is perhaps the oldest method of cost finding in use and without question is the most widely used method today, taking shop for shop. The method is well defined by its name. It is a rough and ready method of costing,—a rule of thumb method under which costs are estimated and are later verified by tests of greater or less inaccuracy.

The manufacturing establishments employing the estimate and test plan are not characterized by accuracy of costs nor, as a rule, by progressiveness of management. It may be said in their favor, however, that they have recognized the need of some cost system, and lacking the ability or the trained assistance for the installation of an adequate system, or perhaps not aware of the fact that more adequate systems exist, have done the best they could.

The estimate and test plan, defined roughly, is any system under which cost calculations in the first place are based on estimates of the quantity of material, labor, and expense involved, and thereafter if the particular operation be of a more or less recurrent nature, a so-called test is applied in individual cases to measure as far as possible the correctness of the preceding estimates. If these estimates prove incor-

rect in the light of the test, they are corrected and stand until further inaccuracies are shown by succeeding tests.

Beyond this, it may be broadly stated that this general plan of costing can be considered as embracing every system of manufacturing cost finding not more or less closely related to one of the four established systems of cost finding, i. e., the specific plan, the sold-hour plan, the list-percentage plan, or the machine-hour plan. In other words, the term "estimate and test" plan is roughly applied to any system not subject to proof by balance and not recognized by modern cost accountants as, under its own peculiar conditions, an adequate system of cost finding.

§ 198. Where the Estimate and Test Plan is Used.

The estimate and test plan is not to be recommended for use under any conditions. To the end, however, that the manufacturer who is now employing some more or less nondescript method of cost finding, may gradually improve and broaden his factory accounting system, a general plan is here suggested which will permit of subsequent development and improvement into a somewhat adequate system. The following discussion is not, strictly speaking, a consideration of the estimate and test plan, but is more a suggestion of what, if physical conditions permit, it can be made.

§ 199. Material.

If anything like accurate results are to be obtained, the expenditure for material must be segregated departmentally, or perhaps by classes of product; as, for instance, in a packing house, expenditures for beef, pork, mutton, etc., or in a saw mill, purchases of beech, elm, poplar, oak, etc. In order to do this it will be necessary to open accounts for the various items in the Factory Ledger, if this be kept in the shape of a separate book. If no separate Factory Ledger is kept, the accounts may be opened in that part of the General Ledger

devoted to factory accounts, which may be considered the Factory Ledger.

Frequently, under this general plan a going inventory by count or weight is maintained, but it is seldom that the financial feature—i. e., the cost of material—is connected with it. This should be done so that when purchases of material are charged to stores and withdrawn on requisition, not only quantities, but the cost of the withdrawn material as well, may be charged to the department receiving same. This financial feature may be added readily and is a long step in the direction of accurate costing.

Ordinarily, when the manufacturer charges material to the department which ultimately makes use of it, he thinks he has gone as far as is necessary in this direction. This is far from correct, but even if he stops here, there should be a transfer made of all material furnished by one department for use in another. If this is done, the net amount of material consumed in a given department can be determined as often as an inventory is taken.

Purchases of supplies will naturally be handled in the same manner as material; i. e., if a store-room system is maintained the supplies will presumably be put in the store-room and drawn on requisition as needed. If a store-room is not maintained, supplies will be charged to the department consuming the same, or if of a very general nature they may possibly be handled purely as an expense item.

§ 200. Controlling Accounts.

Under the estimate and test plan of cost finding there are seldom any controlling accounts to tell the value of work in process at interim periods. On the contrary, material is usually charged to a given department and remains as a charge against that department until the end of the fiscal period. Naturally the account will increase in volume as time goes on so that at the end of the fiscal period—a year or half year

as the case may be—all that is known positively is the fact that so much material or so many dollars and cents worth of material has gone into that department.

Some concerns maintain a monthly loss and gain account operated on an arbitrary basis, and pass credit to the material and labor accounts each month, charging same to representative cost accounts. Such a plan is embodied in the working chart of the estimate and test plan shown in Figure 5.

§ 201. Labor.

Under the estimate and test plan, labor costs may be determined by the order number estimate (§ 84), or where the piece-work plan of payment prevails (see § 22), the more or less exact amount of direct labor cost as against which successive jobs may be positively allocated. Indirect labor may be applied as a percentage on direct labor.

§ 202. Expense.

All expense items should at least be properly segregated between departments under one of the plans discussed in Chapter XVII. In many plants this is not done and in such case a large part of the value of the cost records is lost.

This requires a record of specific time consumed on certain factory orders, as otherwise there is no choice of methods offered for diffusing the departmental expense over product. The only plan then available is a percentage on labor cost, or on material cost, or on both as described in § 188.

§ 203. Cost Tests.

The exact method of making cost tests under the estimate and test plan can hardly be outlined, as these tests will vary with the product. Estimates of materials are easily verified. Labor cost is much more difficult, as on a test the labor conditions are entirely different from those of regular production work, and the results accomplished are not those usually at-

tained. For this reason labor tests are apt to be entirely inaccurate and unsatisfactory—a characterization which may well be applied to the whole system of estimate and test cost finding.

Specific Plan of Cost Finding.

§ 204. Characteristic Features of Specific Plan.

The specific plan of cost finding is at once the most simple and the most complex of the various methods of finding costs. Its simplicity lies in its directness, for the material and labor consumed, and the expense incurred in the production of a specific order number are, as far as possible, applied directly to that order number. Its complexity is due to the fact that every order number must be treated separately and this involves a multiplicity of detail, a close watch, and an accurate record beyond that required by any other method of cost finding.

The specific plan of cost finding is an ideal system where it can be economically employed. It is the most accurate of all systems, for every cost incurred on a particular job is charged to that job. This largely avoids the averaging, the estimating, and the reservations for variations, characteristic of every other adequate system.

The application of the specific plan of cost finding requires certain conditions, not only of product but of administration. The product must be one in which each order number can be kept separate and distinct from all other order numbers. Beyond this, as each order number is treated separately, it requires a large amount of detail work, a sharp distinction between order numbers, an equally sharp division of costs, and an accurate record. Because this sharp, detailed precision of operation will not be enforced, the system cannot be used in many cases where it might otherwise be advantageously employed. The specific plan of cost finding is, as stated, the most accurate of all systems when properly car-

ried out, but is less accurate than most others when it is not properly carried out.

When the specific system is used, the detailed charges to each department order number must, at the end of the month or cost period, tally with the total departmental charges for that month or cost period—a condition which, while invaluable for checking purposes, requires an absolute precision and unvarying attention to details which cannot always be secured.

The operations of the specific plan of cost finding, the relations of the various records, and the forms employed in connection with it, are shown in Chapter XXX, "Chart of Specific Plan."

§ 205. Material.

Under the specific system of cost finding, the material used in each order number is charged to that order number at cost. Supplies used for a certain order number are similarly charged at cost. In this the system does not differ in any way from other systems of cost finding.

§ 206. Labor.

As in the case of material, labor required for the production of a certain order number is charged to that order number at pay-roll cost. Thus, if a certain order number requires the attention of a skilled mechanic receiving $3 for an eight-hour day and the services of an assistant at $1.50 per day, each for four hours, the job is charged $1.50 for the skilled labor and $.75 for the services of the assistant. In other words, the job is charged at cost for what it gets.

For its proper operation the specific system requires continuous employment, as otherwise idle time must be provided for. Where idle time is unavoidable it is distributed as part of the expense burden.

§ 207. **Expense.**

Under the specific plan of cost finding, expense is charged to each separate order number in equitable proportion. This proportion may be determined by any of the methods for expense diffusion, though for general purposes the man-hour method will be found the most accurate and satisfactory; or where machines are largely used, the machine-hour plan of expense distribution may be employed as far as machine work is concerned.

In the application of the specific plan of cost finding, other plans may be utilized in part or even in whole. Thus in one department the machine-hour will perhaps be employed; in another department the sold-hour plan, and in another department the list-percentage plan. Such diversity of plans in one establishment is but seldom found, but the use of two plans of more or less distinctive characteristics in a single establishment is frequent. On the other hand, a single plan might be employed, as for instance, the machine-hour plan, for, broadly defined, the specific plan is merely a method of finding accurate costs for specific order numbers, and these costs may be ascertained by any plan of cost finding that will meet this requirement.

It will be noted that the specific plan and the estimate and test plan of cost finding are almost diametrically opposed. Under the estimate and test plan the first estimates are usually but little more than guesses, not provable by balance and only subject to correction by later tests. Under the specific plan, on the other hand, nothing is done by guesswork, but each and every item entering into product is carefully weighed or measured, and at all times, and at all points, if properly operated, its results are subject to proof by balance.

CHAPTER XX.

THE SOLD-HOUR PLAN.

§ 208. Characteristic Features.

The sold-hour plan is a method of applying manufacturing costs to product on the basis of the hours of labor involved. It is somewhat analogous in principle to the machine-hour plan but differs in the method of application, inasmuch as under the machine-hour plan the operator is considered as incidental or auxiliary to the operation of machines, and under the sold-hour plan any mechanical aids are considered as incidental or auxiliary to the work of the operator. In other words, under the machine-hour plan costs are applied to product "through the machine," while under the sold-hour plan they are applied "through the machinist" or otherwise through productive labor.

The results secured under either methods are, of course, practically identical; i. e., the detailed cost of product; and under both methods costs are charged on a time basis, but in the machine-hour plan this time is the used or "sold" machine hours, and in the sold-hour plan it is the used or "sold" labor hours.

Another distinction must be made between the machine-hour plan and the sold-hour plan. Under the machine-hour plan, costs are charged through each individual machine, or through groups of machines called "production centers." Under the sold-hour plan, charges are not made through the individual operator, but are made through the productive labor of the department as a whole. In the one case the costs on a particular job are determined by the number of hours it occupies the operations of particular machines, the cost

varying with the machine. Under the sold-hour plan it is determined by the number of productive hours devoted to it without regard to the individual by whom such service is rendered.

In choosing between the two plans, when either may be used, the proportion between expense and labor in the cost of the particular product has an all-important bearing. When, as is usually the case in machine work, the expense involved exceeds the labor cost, it is better to base the calculation on machine time; but if the expense involved is less than the labor cost, it is better to take labor as the basis of calculation.

The sold-hour plan necessarily requires a record of the time devoted to every order, and there is no means of combining or grouping orders to save clerical labor unless costs are wanted only on the group as a unit.

§ 209. Where the Sold-Hour Plan May be Used.

The sold-hour plan is used to advantage in plants which are devoted largely if not entirely to special work or "order" work of such a nature that practically all the operations in each department may be performed by all employees in that department, and in which the assignment of successive orders as they come in is governed more by the conditions of work on preceding orders than by the peculiar skill or other qualifications of particular employees. Thus, for instance, in a machine shop devoted to experimental work, perhaps any one of the machinists employed is capable of undertaking any work coming into the shop, and a waiting job is assigned to the first man who is at liberty to take it up. The same condition obtains in a printing office where as a rule work coming into the composing-room is assigned to the first available compositor without regard to his qualifications, or coming into the press-room is put upon the first idle press capable of performing the work, without regard to the skill of the pressman in attendance.

Where work is of this nature there is usually a fairly well averaged rate of wages—a condition necessary for the proper working of the sold-hour plan. Where wide variations of wages exist, the plan is not to be recommended. Thus, in a plant devoted to standard work, each operation is usually given out to employees who are specially trained or fitted for that particular operation and who can therefore accomplish much more in a given length of time than could other employees in the same department. As the skill of these operators and the importance of their work varies greatly, there is a correspondingly wide divergence in their wages, effectually preventing the economical use of the sold-hour plan.

It is true that these same conditions of peculiar training or skill obtain in special work to a limited extent, but usually wage divergencies in such work are not sufficient to prevent the fairly accurate operation of the sold-hour plan. Occasionally some particular job may come in requiring the attention and therefore the employment of a specially trained operator, who may be paid a higher wage than his fellows. To counterbalance this, some few lower-waged operatives or apprentices are almost always found in such establishments, the general result being a fairly well averaged wage-rate.

§ 210. Finding the Sold-Hour Cost.

The total pay roll of a department for a given cost period divided by the total number of productive hours in the department for that period, gives the pay-roll cost of its chargeable hours. Add to this pay-roll cost the proper quota of expense burden, and the result is the sold hour; i. e., the entire averaged production cost of an hour applied to a specific order in a given department.

The determination of the departmental expense burden is not a difficult matter. Rent, light, heat, power, and the hundred and one other items that go to make up the burden

of expense for the cost period, are segregated as far as possible into direct charges to departments. The balance of undistributed expense is allocated to the different departments on such basis as may seem equitable. The total of these direct and indirect expenses gives the total departmental expense burden for the cost period, which divided by the total number of productive hours in that department for the same cost period, gives the expense burden for each hour. This added to the hourly labor cost, gives the total cost of the sold hour. In practice, to determine the total cost of the sold hour, the pay-roll costs and the expense costs for each department are added and this total is divided by the productive hours of that department.

The departmental cost sheet (Figure 180) is conveniently employed in determining the cost of the sold hour. The amounts of pay-roll cost entered under the various department heads on this form are taken from the "Total Amount" column of the pay-roll blank (Figure 131), the sheets for each department pay roll being totalled separately.

The various items of expense are first segregated, preferably as set forth in § 94. Instead of the form shown in Figure 141, analysis paper properly ruled but without printed column headings, may be used. When this is done, the various columns are given suitable headings under which the expense items are collated. The totals of these columns are allocated to the various producing departments upon the basis set forth in Chapter XVII.

In the distributing process, some portion of expense will naturally be chargeable against non-producing departments, such as "stores" or "office" (expense). When the charges to non-producing departments have been totalled, they are distributed over the producing departments on such a just and equitable basis as may be determined.

In the departmental cost sheet shown in Figure 180 space is provided at the heads of the proper columns, to show

the departmental investment and the number of square feet of floor space occupied by the department. These items will not ordinarily be entered on the sheet, inasmuch as their amounts vary but little from month to month.

At the end of the first cost period the records of each department will show the cost of the productive hour in that department for the period, and cost sheets compiled for this period must of necessity use these figures, since there are no others to use. As a matter of fact, however, the costs found for a single period do not present a safe basis for estimates of prospective work. Hence, when two periods have elapsed, it is the part of wisdom to strike an average of the cost per sold hour for the two periods, and, again, when the third period has elapsed, to strike an average for three periods. Some concerns use an average based on an entire year. So long a period is hardly necessary, but six months is not too long, the six months last passed always being used, and a new calculation being made each month or period. The mean average will ordinarily vary but little.

On the general books, actual costs are charged to the various departments on a positive basis, as for instance, departmental pay rolls are charged to the departmental labor account; the expense apportionment to the expense account; and material to a material account. Under this plan of cost finding the corresponding credit is passed to the various departments by maintaining for each an account called "Process," to which is credited at the sold-hour rate of such department all goods or jobs finished in the department, together with the cost of material used in this finished work.

Theoretically, the debit balances of the material, labor and expense accounts of each department should be offset by the total credit of the "Process" account. In practice such an "evening up" will not occur for the reason that while costs are credited to the department on an average basis, they are charged to it on a positive basis. Thus, for example, in us-

ing for the third month or period the averaged sold hour of the first two months, the sold-hour cost may be $.755, whereas the actual costs of the third month or period are $.768. This sharp increase will necessarily place a debit balance on the Factory Ledger larger than the credit balance based on a lower sold-hour cost. This, however, usually averages itself as time proceeds. If the debit balances should at any time become too large, they can be adjusted by a charge to the reserve account "Factor of Safety" (§ 157) which, when the sold-hour plan is used in connection with double-entry books, should always be set up.

§ 211. Material Costs.

Under the sold-hour plan, as under any other accurate plan of cost finding, a strict accounting for all materials and supplies is an essential feature. In large concerns one person should have direct control of the stock-room or material stores and no material should be issued by him except on a regular requisition properly signed by a person authorized thereto. After filling an order the stock clerk passes the original requisition to the cost clerk to be charged against the job on the individual job record (Figure 181) and also to be put through such other channels as the records of the individual shop may require. If the shop is large enough to warrant a stock ledger, the stock clerk or storekeeper enters the requisition on this record, deducting the amount given out, and thus showing the balance still on hand.

In the medium-sized shop the job ticket or job follower (Figure 21) should accompany the requisition, and, to prevent accidental or intentional duplication, the stock clerk should so stamp or mark the job ticket as to show that the material has been delivered.

§ 212. The Job Follower.

In those plants where written details, blue prints, draw-

ings, copy, or other data usually accompany an order, the use of an envelope form of job follower (Figure 21) is recommended, purely as a matter of physical convenience. Into the job follower envelope are placed all instructions, papers, etc., required by the workmen in connection with the job, and in this envelope they are kept except only when in actual use. This plan minimizes the danger of losing or misplacing important papers, and also insures the preservation of a complete history of the job, valuable for future reference and free from the destructive influences of time and dust to which such records are usually subjected.

Under some plans of labor reporting it is possible to collate all the time records on a given job. Where this is done they can, if desired, be permanently kept in the job follower envelope. In Figure 117 is shown a good form of time card for this use, as the coupons are small and therefore easily contained in the envelope.

On the face of the job follower is space for full instructions relating to that job for each department of the plant. It should be the rule to fill out each job follower in such detail that from start to finish of the job it is not necessary for any employee to look elsewhere for his instructions than to the space allotted his own department on the job follower.

The job follower accompanies the job through the various processes to its completion. The follower has then fulfilled its immediate functions and becomes part of the records of the business, to be filed away for possible future reference. There are numerous filing devices on the market which can be used for this purpose. Ordinary pine boxes made perhaps 30 inches long with height and width to fit the job follower, are effective for these containers. These pine boxes need have no cover, and, stacked with the uncovered side out, permit of easy access to the envelopes when occasion arises.

Whatever the plan of filing followed, conspicuous labels

should be used to indicate the job numbers contained in each file in order to facilitate ready reference.

§ 213. The Job Cost Sheet.

The office record of each job is kept on a job cost sheet (Figure 181). This should ordinarily be large enough to record the full details of special work and is preferably ruled and printed on a sheet suitable for preservation in a loose-leaf binder. When this is done the successive sheets are, as a matter of convenience, numbered consecutively to correspond with the job order numbers, the number of each sheet then indicating both its position in the file and the order number of its job. As the report of each job comes in for entry its details are recorded on the job cost sheet bearing the corresponding job number.

The form of job cost sheet shown in Figure 181 is the form adopted and made standard for the use of printers by the American Printers Cost Commission. Its use is, however, by no means limited to the printing trades, nor is the printing industry limited to this particular form.

On the reverse of this or similar job cost sheets can be shown any desired data from the job follower. Where the blanks on the reverse of the cost sheet correspond with those of the job follower, the necessary data for both can be written upon both the cost sheet and the job follower at the same time by the use of carbon paper. This not only precludes the necessity of filling out the two separately, but, the original impression being out of reach, makes it difficult if not impossible for the employees to manipulate figures so as to cover up errors or accidents.

As time reports are turned in each day, they serve incidentally as job tracers, readily showing the whereabouts and condition of any work in process.

The job cost sheets are referred to more frequently than any other records kept under the sold-hour plan. This is

because they contain the gist of that which a cost system primarily aims to disclose, i. e., costs on individual jobs. It will show what records are kept, the time consumed on each operation, the labor cost, the material used, both by quantity and money value; and finally a summing up of the cost of labor (this including expense) and material to show the total cost of the job and the proper selling price thereof.

When the job is completed, the cost computed, and the job charged to the customer, the job cost sheet should be taken out of the binder and filed in a transfer binder, or, if desired, it can be enclosed in the job follower envelope. By removing the completed sheets from day to day, as work is finished, there are left in the binder only the "live" jobs which are still in process. The cost sheets in the binder then constitute what is practically a going inventory of goods in process which should exactly articulate with a controlling account, "Goods in Process," in the Main Ledger.

§ 214. Production Order Register.

Under certain local conditions and with product of a certain character, it may be found advantageous to use the Production Order Register instead of the series of job cost sheets. Figures 27-30 present a form of Production Order Register which answers the purpose, and, if used, articulates well with the other records. As many lines as necessary may be allowed for each succeeding shop order as it is entered, the number required in each case depending on the character of the work, the complexity of the entries involved, and also whether the labor reports are collated and added before entry or whether such entries are made in detail on the Production Order Register.

In case neither of the plans referred to are used, then an adding machine total for each pay period will give the amount for entry in the labor column of the Production Order Register. If a certain job is held up for any reason, there

are, of course, no time tickets on the job and no entries in the Production Order Register until work is resumed.

By using various colored inks for entries (one color for each month or cost period), there is no difficulty in separately footing the figures of the various months or cost periods, even though certain jobs—as is frequently the case—run over from one cost period to another, or, as not infrequently happens, run into a third period.

It will be noticed that the page of the Production Order Register shown in Figure 29 provides for three separate footings, its footing lines being intended respectively for the first, second, and third cost periods. When all the time report totals have been entered for the monthly cost period, the totals can be taken for the various sheets of the Production Order Register and from these a grand total or summary. This grand total must, of course, exactly equal the amount of the costs that have been entered, and as a precautionary measure should be checked from the other records, which show the total of material issued, total pay roll, expense expenditures, etc. The next month the operation is the same, the picking out of intermingled figures for the different totals being aided by the different colored inks. In this way a controlling record is maintained. Orders that are still in process unfinished at the end of three months can be carried forward to a new sheet.

If it is desired to use the job cost sheets for specific data and the Production Order Register as a controlling account, then a modification of the Factory Order Register shown in Figures 38 and 39 may be used to put the plan on a proof by balance basis. As will be noted, the page shown in Figure 38 deals only with the physical data, the financial record appearing on the page shown in Figure 39. The arrangement of Figure 39 is designed for use with the list-percentage plan but may readily be adapted for use with the sold-hour plan by combining labor and expense under one heading to represent

the "sold hours." "Process" on this form designates work in process received from a preceding department.

The method of keeping the Factory Order Register is the same as that followed with the Production Order Register, with the added feature that as orders are finished an entry is made in each credit column (with ink of the color used for the current month) of an amount equal to all of the amounts of debit against the order in that particular group.

These credits not only show the totals of costs in each department but then serve to give credit to the "Goods in Process" account by means of a grand total. The grand total is credited on the "General Exhibit" (Ch. XXXIV) to "Goods in Process" and charged, at cost of goods sold, to the current Loss and Gain Account.

§ 215. Time Reports.

Every employee should be required to render a daily time report showing the disposition of his total employed hours. This report is in effect the itemized bill of the employee for his day's labor, and from it, if a proper plan be followed, is made up his pay-roll record.

To insure exact time on each job, a time-recording device of some type is desirable. Also a careful choice of time-reporting plans should be made in order that the needs of the sold-hour system may be properly met. Reports that are in themselves complete so that they may, as they are received, be distributed physically to the job number to which they belong, are preferable to those that are collective. The former lend themselves much more readily to the use of mechanical aids and to short cuts and are less cumbersome in every way.

In plants where for individual reasons a time-recording device is not used for "on and off" time on each successive job, a form of time ticket is illustrated in Figure 121, which is simple and effective and well adapted to the sold-hour plan of cost finding. This, however, entails more effort than

is required when a time-recording device is used, and its record is necessarily made by the individual employees instead of by a time clock.

When a form similar to that of Figure 121 is used, it must be adapted to fit the conditions and class of work of the various factory departments. Usually a list of operations peculiar to the individual departments are printed on the back of the time ticket, each operation being given a symbol number for ready designation. The employee in making out his report writes the proper symbol number in the column headed "Kind of Work," opposite each job number on which he reports time. The last two columns on the right are reserved for the entries of the cost department clerks.

After having determined what operations are chargeable as a direct charge to the customer and what are non-chargeable, it is simple enough to divide the time on the ticket under the proper headings, this being done by the cost clerk after the ticket reaches the office.

The time report shown in Figure 121 is so arranged as to be suitable for either time-work or piece-work. Even in time-work it is usually advisable to record the quantity or number of units turned out, and under piece-work a record of time occupied is desirable, as the use of this information will on occasion greatly assist in compiling estimates.

The form of time sheet shown in Figure 123 is somewhat similar in appearance to the form just discussed, but is different in operation in that it partakes more of the nature of the time reports under the machine-hour plan. The form as shown is adapted for use in machinery departments where the machines are practically all of a similar type. Where the types differ widely, subdivisions are necessary. Thus, in a printing plant, for cost purposes separate classifications should be made for platen, cylinder, and perfecting presses. This is because the expense element varies with each different class or type of machinery. Further groupings into production

centers composed of given sizes of machines, or based on other attributes, may be made when desired.

§ 216. Machine Production Record.

Where machinery is involved, no matter what the general system of cost finding may be, it is essential to the management to know, not only the chargeable and non-chargeable hours of labor or machines, but to know the product by units each day from each machine; also the time required to get that amount of product out, how much time was expended in preliminary preparation, and how long each day the machine was idle.

In Figure 179 is shown a form of machine record which properly used will show exactly how many units of product are being turned out each running hour, thereby showing whether or not the machines are being used to the best advantage. The entries on the machine record are made from the daily time report (Figures 123-125) of the machine department, which shows the totals for the day's record of time.

The machine report is one of the most valuable records of the sold-hour system. It is of a "tell-tale" nature, indicating the pulse beat of the plant, and, properly used, constantly tending to an increased production at a decreased cost.

The importance of maintaining a definite degree of machine efficiency is readily understood when we consider that in the ordinary well-equipped plant the complement of each kind of machine is only sufficient for reasonable operating requirements, and, if any one of these falls below its proper output, machines dependent upon it for work must also fail similarly, the output of the whole plant be "held up" or diminished in proportion, and the profits fall off in a much larger ratio. The average employee does not recognize this fact, nor, unless employees are upon a premium-earning basis or in some other way, friendly or financial, interested in the success of the plant, would it appeal to him if he did.

§ 217. Departmental Pay Roll.

The pay roll has perhaps more to do with the accuracy of the entire cost system under the sold-hour plan than any other blank or form. The pay roll of each department should be kept separately, and these department pay rolls should agree with the corresponding department entries on the recapitulation sheet of department labor costs (Figure 130).

Employees working in several departments on and off, should be instructed to turn in a time ticket in each of these departments. The name of such an employee will then appear on the pay roll in as many places as departments in which he has worked. This need, however, cause no discrepancies or even inconvenience, as his "In and Out" time will naturally be checked against his pay-roll time, and by the exercise of a little care one pay envelope can be made to include his pay from all departments in which he has worked.

The record of each employee of a department is kept in the pay roll of that department. This shows how much time is chargeable and how much is non-chargeable to customers, and, taking the department as a whole, it will show what percentage of the entire pay roll is non-chargeable,—a barometer by which the efficiency of the management may be gauged.

§ 218. The Recapitulation Sheet.

The recapitulation sheet of department labor costs (Figure 130) should be so kept that comparisons can be made from month to month and from year to year. Headings should be made for each department of which a record is to be preserved, and these headings should correspond with the headings shown on the statement of cost (Figure 180).

The figures to be recorded on each recapitulation sheet cover a period of one month and will show the chargeable and non-chargeable time by departments. This information is invaluable for comparative purposes, showing among other things whether the percentage of non-chargeable time is within

reason and whether it is increasing or stationary, and also whether proper costs are being figured in the various departments.

§ 219. Departmental Cost Sheet.

The departmental cost sheet (Figure 180) is, in effect, a condensation of production facts and figures. The periodic entries on this form may be made, if desired, at three or six months' intervals, but if made monthly the practical value of the sheet will be greatly increased. It is a foregone conclusion that the results of the cost sheet will vary from month to month, but these variations are not apt to be material and if they occur the fact should be known. The departmental cost sheet will, of course, show these variations and will also show their cause.

If the departmental cost sheet is properly filled out, an accurate statement of the cost of production on the averaged hour will be had. Where double-entry records are not kept, this information can only be applied in a general way to certain orders. The full benefit of the plan cannot be secured unless the records kept are such that this hour cost can be applied to each and every order and when so applied be subject to proof by balance.

In the records of the departmental cost sheet it is not essential to have the various departmental investments displayed each month, nor yet the number of square feet of space occupied.

As sometimes employed, the sold-hour plan contemplates adding to product the burden for commercial costs as well as manufacturing expense. This feature is not necessarily used, but, where desired, the charges for commercial costs can be handled through the "General Expense" column of the cost sheet and be distributed over departments together with other general expense items (as per 18th line on Figure 180).

This is done by taking the labor cost of the sold hour

in each department, plus the direct and diffused expense (as per 19th line, (Figure 180), and then determining what percentage the total of such cost for each department bears to the grand total of all departments. The percentages thus obtained give a basis for dividing the general expense and the commercial costs over departments. In the departments, the general expense and commercial costs are applied on the sold-hour plan.

CHAPTER XXI.

THE LIST-PERCENTAGE PLAN.

§ 220. Characteristic Features.

The list-percentage plan of cost finding takes its name from the distinguishing fact that the charges for each element of production cost in each department—determined in advance—are expressed as a percentage of an arbitrary list price. This list price may or may not be the list selling price of the product. As it merely gives a convenient basis for the percentage expression of costs, its exact amount is a matter of some indifference. The list-selling price of the particular product is, however, usually taken as its list-percentage price.

The list-percentage plan of cost finding is also known as the "process" plan or method, because of its wide application to mass products or process products, in which the goods under any specific order numbers are either not easily distinguishable, or follow each other in such rapid succession, or in groups of such similar characteristics that the product can, for costing purposes, be handled in mass more conveniently than by specific order numbers.

Where the list-percentage plan can be used it is simple and effective, but it is advantageously employed only with products of reasonable stability as to production costs and conditions, since it lacks the quick sensitiveness to cost variations of some of the other cost-finding plans, and too frequent changes of its cost percentages are troublesome and confusing. The products to which it is applied must also possess certain other characteristics, set forth in the following section.

§ 221. Where the List-Percentage Plan May Be Used.

The list-percentage plan can be used to advantage only in processes in which, under the conditions and efficiency stand-

ards existing in the individual plants, the maximum possibilities and the minimum departmental working requirements are known. With such processes the more or less exact sequence in the movement of goods in process from one operation or department to another may be intelligently anticipated, and, with due regard to possible contingencies, the goods may be passed through with reasonable precision and in conformity with a predetermined plan. Deviations from schedule time may be troublesome but will not seriously disturb the operations of the list-percentage plan.

Processes adapted to the operation of the list-percentage plan must involve but little, if any, special work and this special work—where more or less does exist—must be capable of being cared for by a specific cost finding plan applied to individual orders, and this without disturbing the cost record for the major part of the product under the list-percentage plan.

It is also essential that the processes brought under the list-percentage plan be such that material can be supplied or issued in quantities capable of predetermination or of subsequent specific demonstration, and such that all by-product, usable waste, and offal costs may be properly allocated.

The production processes which embody the foregoing requirements and in which the list-percentage or process plan of cost finding is employed to advantage, may be enumerated as follows:

(1) Mass products, in the preparation of which the proportion of labor to material used is fairly standard, not only through the one cost period but in each recurring period as well, save as it may be modified by conditions of sufficient permanence to be recognized in the cost percentages.

Examples of this kind of production are fustian, breakfast foods, common soap, manufactured tobacco, angle iron, binder twine, fence wire, common brick, cotton cloth, flour, varnish, and other similar products where the exact amount

to be produced is not of necessity positively predetermined, but in which production is capable of being conducted on the continuous performance or "till forbid" plan.

(2) Standard grades of product where each successive order has to a large extent identical or similar labor processes or operations performed on material similar as to general characteristics though of possibly differing quality, sizes, or colors. The processes employed are of such a nature that the volume of work put in process may be made up of a greater or less number of individual production orders of clearly defined quantities.

Examples of such products are agricultural implements, furniture, mixed paint, wire nails, shoes, candy, tacks, rope, gloves, dress-goods, toilet soap, and harness.

§ 222. The List Price.

A compilation of list prices on product is an essential feature of the list-percentage plan. With the list price of each product as a basis, the costs of material and labor, and the burden of expense in each of the successive production departments through which the goods in process pass, may be readily expressed as percentages.

Thus, suppose a given production order consists of twenty units at the list price of $12.50 each, giving a total for the production order of $250 list. The tabulation of percentages will then perhaps show the cost of this particular product in the various departments as follows:

Department	Process	Material	Labor	Expense	Total	Dept. Costs
A	.....	7.0	3.0	2.5	12.5	12.5
B	12.5	4.7	2.9	2.4	22.5	10.0
C	22.5	3.6	2.6	2.1	30.8	8.3
D	30.8	2.9	5.2	4.9	43.8	13.0
	.....	18.2	13.7	11.9	.....	43.8

The list price of $12.50 per unit may or may not be the list selling price, or it may or may not be used as a basis for arriving at the selling price. These features have no necessary bearing on the determination of production cost, for which the list-percentage price is primarily selected. Thus, the list price of $12.50 per unit in the example given is merely a convenient monetary expression of 100% of one unit, and if any cost is 10% of this list price, the monetary expression of this cost is $1.25, which may or may not be the actual money cost. Theoretically, and for the most generally useful operation of the plan, it should be, but even where this was originally true, tests may show that changing conditions have worked a material variation between the actual cost and the cost shown by the monetary expression of list percentages. Also, arbitrary list prices are sometimes selected for the express purpose of concealing actual costs.

In practice the cost percentages are usually reduced to money values, to the end that each of the several producing accounts may be given proper credit. Thus the foregoing percentage tabulation for twenty units of product at a list price of $12.50 per unit, worked out, would show as follows:

Department	Process	Material	Labor	Expense	Total	Dept. Costs
A	.....	$17.50	$ 7.50	$ 6.25	$ 31.25	$ 31.25
B	$31.25	11.75	7.25	6.00	56.25	25.00
C	56.25	9.00	6.50	5.25	77.00	20.75
D	77.00	7.25	13.00	12.25	109.50	32.50
	.....	$45.50	$34.25	$29.75	.....	$109.50

§ 223. List Percentages.

When the list price has been determined, the percentages of the various constituent elements of cost in each department are estimated and expressed as percentages of the list price. These percentages are worked out in advance, are tested in ac-

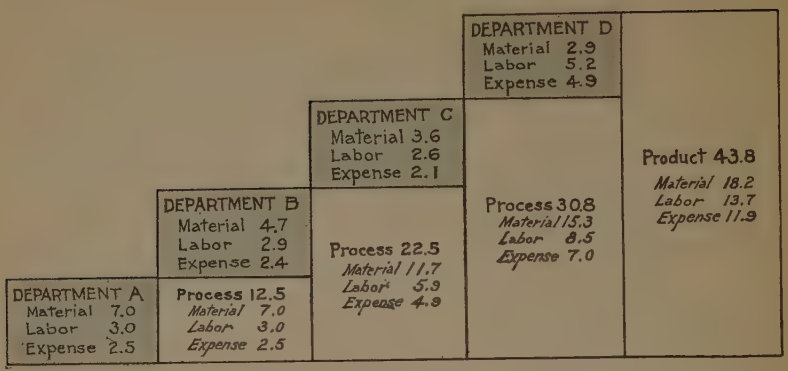


FIG. 3. Diagram Showing Increase of Manufacturing Costs by Departments.

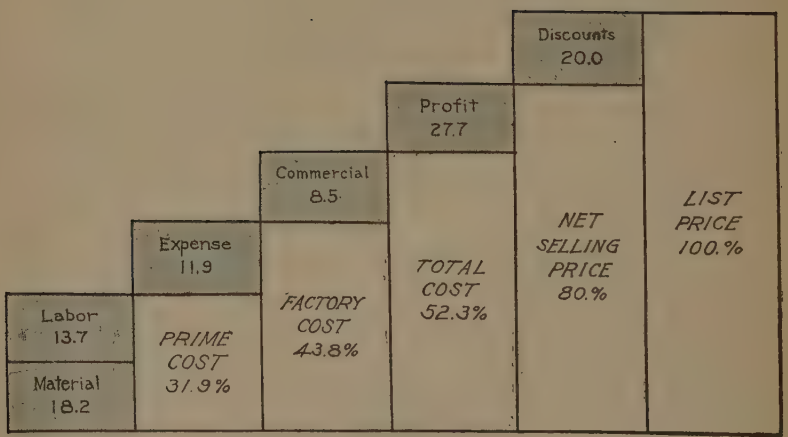


FIG. 4. Diagram Showing Increase of Manufacturing Costs by Percentages.

tual practice, and no change is necessary until tests, or the balances at the close of cost periods show variations in the cost.

Thus, in the example given (§ 222), in the department where the first operation is performed—where the material is put "in process"—the cost of material is fixed at 7% of the list price of $12.50 for the unit of completed product, labor is placed at 3% and expense 2.5%. In the second department the costs for material are 4.7%; for labor 2.9%, and for expense 2.4%. In the same manner, in each of the other producing departments this same percentage expression of costs is carried out.

The advantage of expressing the departmental costs as percentages lies in the ease of calculation, of record, of comparison, and of change when necessary. In practice, as stated, the percentage tabulation is usually reduced to money values for accounting purposes, but this does not in any way affect the use or the convenience of the percentage expression.

The cost percentages for the various departments are obtained in the first place from the records of past cost experience and should be approximately correct. Tests are, however, made from time to time, first to demonstrate the accuracy of the estimated percentages and thereafter to show any variation of cost from the percentages as fixed. At the end of each cost period the total percentage costs shown by the departmental records must, of course, agree with the actual costs for material issued, labor employed, and expense incurred for each department.

The percentages once properly fixed give a fair average of costs under normal conditions. Thereafter, as stated, tests of specific order number costs will from time to time show any variations from this average. If variations are found, their cause is determined and if they are due to conditions which permanently change such costs in any way, the percentages are changed to correspond. No change is made, however, for any temporary variation, such, for instance, as

might result from a chance difference in texture of material, necessitating a greater or less amount of labor. Such fluctuations are of no statistical value and are not reflected in the list percentages.

§ 224. Arbitrary Figures of the List-Percentage Plan.

The arbitrary list price of the list-percentage plan is merely employed as a basis of computation—a known starting place from which costs and their fluctuations may be recorded by means of a convenient system of percentages.

An objection to the list-percentage plan frequently urged is the variation of its percentages. These percentages undoubtedly will vary as conditions change, but so will costs under any accurate plan of costing, and if such were not the case a cost system would become more or less superfluous. The "Summary of Costs" shown in Figure 100 is used to keep a close record of variations of cost.

The list price and its percentages under the list-percentage plan are standardized costs. "Standard costs are the mariner's compass of a business enterprise, showing as they do from month to month the proper course of the business ship. * * * Predetermined costs, although of immense practical value, are subject to a slight disadvantage, more theoretical than actual, which nevertheless may prejudice adherents of the old school against the new methods. The drawback is that predetermined total costs do not agree with actual expenses over the same period. Let it be remembered, however, that this lack of agreement is no more important than is the lack of agreement (except at two moments of the year) between siderial time and sun time, the lack of agreement between standard railroad time and local clock time, the non-agreement between magnetic north and true north, the non-agreement of the Pole Star with the true north, or the non-existence of any constant true north, since even the axis of the earth wabbles."*

* Emerson, "Efficiency," pp. 120-122.

So with the arbitrary figures of the list-percentage plan. As a rule the standard figures approximate the actual costs—so nearly that selling prices may ordinarily be based on them with entire safety. Their chief function is, however, to afford a basis of comparison by which fluctuations of cost, whether up or down, may be clearly shown, and this the standard figures of the list-percentage plan will do. If efficiency operations are in progress which should reduce costs, the management have a standard by which any reductions attained are sharply shown. If accidental causes increase costs, the test will show this increase and the percentage expression will show its amount, and the management may then take such steps as they deem best. The cost system will indicate the conditions. It is for the management to determine what these conditions demand.

As a rule, the arbitrary figures used in the list-percentage plan are as near the actual figures as it is possible to arrive. If, however, there is any reason for keeping actual cost figures from all but one or two trusted employees, absolutely fictitious figures may be used for the list prices. Then the apparent cost prices as obtained from the percentages are absolutely false and misleading, but the same percentages calculated on a truer list price—which is not known to the employees or outsiders—give the real figures of cost. In any such case of actual and fictitious figures, extreme care is, of course, necessary to avoid confusion.

§ 225. Operation of the List-Percentage Plan.

Practically the same costing forms are used for cost tests under the list-percentage plan as are used under the specific cost-finding plan, varied only by the important fact that under the list-percentage plan each and every individual shop order does not of necessity go through the costing process.

Figure 202 shows the office copy of a schedule—not a cost test—passing through the milling department of a soap

works. The form for other lines of product will vary with the individual needs. The office copy of the schedule shown is merely the basis for an entry from the milling department or process to the wrapping department. It is from these forms in their entirety that the elemental accounts get their credits and the successive "process" (or semi-finished product) accounts get their debits in each succeeding department. Where orders are put through in groups, such figures embody data for the entire group.

Where the actual costs of material, labor, and expense in each department are charged to the accounts representing these elements, and the offsetting percentage credits have been passed to them also, then the resulting balance, if any, in each departmental controlling account when that department is entirely cleaned up of schedules, should show clearly the actual variation in cost on the entire volume above or below the arbitrary figures. It is, however, possible, and it occasionally happens that a controlling account will be found in almost perfect equilibrium, notwithstanding the fact that costs on the individual orders have been either higher or lower than the arbitrary figures. This is due to the fact that orders have varied inversely to such a degree as to approximately offset the variations.

To avoid being mislead by these possible offsetting variations, cost tests should be frequently made. In cases where the orders passing through are very similar to each other, there is not the same need of often repeated tests and they are then made at periodic intervals or when the indications, as reflected by the balances of the controlling accounts, point to a positive and material cost variation in some class of orders which have recently passed through.

As will be noted, the list-percentage plan of cost finding is very flexible. It may be expanded or contracted to meet individual or seasonal requirements. It enables the management to find detailed costs on as many or few specific orders

as may be desired, while at the same time the fact that any material variation in aggregate costs is bound to be reflected in the controlling accounts is a continuing check on the general current costs.

§ 226. Departmental Accounts.

Under the list-percentage plan, departmental cost accounts are kept in each department. When goods come into a department they bring with them the costs already incurred in the preceding department or departments. This charge is not detailed—since details may always be found in the records of the preceding departments—but is made in one total under the head of "Process."

The process charges to each succeeding department are the actual costs of the labor, material, and expense incurred in the preceding departments. A curious departure from this principle of charges at cost occasionally obtains, under which profits are allotted each department and charged with the costs to succeeding departments. "A typical example of such a condition of affairs will be found to obtain in a boot and shoe factory. The procedure in such cases will be similar to the Departmental Accounts, save that each department, after the first, must be treated as purchasing from the preceding department its manufactured product. A definite scale of prices must therefore be arranged as between one department and another, each department being treated as having earned its profit as soon as it has completed its part of the whole process of manufacture. This system lends itself readily to the preparation of detailed and accurate accounts, and (speaking generally) infringes no fundamental principle of accounting. It is important, however, when preparing the financial accounts at the end of each period, to broadly review the general position, with a view to guarding against partly finished goods being taken into stock at a sum in excess of actual cost unless there is every reason for supposing

that the manufacture will in due course be completed and the articles then find a ready purchaser at the normal price. If there be any doubt under either of these headings, a reserve should be made against any possible loss on the work already done in the earlier departments of manufacture."*

There would seem to be little to commend such a plan. No profits are made until goods are sold, nor can either the factory as a whole, or any department therein be consistently considered as making a profit. The factory delivers its product at cost to the commercial department, and it is the function of this department to realize profits for the entire establishment. The province of the manufacturing department is to turn out goods of a desired quantity and quality at as low a cost as possible, and when this is done its responsibility is at an end. The departmental cost figures cease to be cost figures when they include an element of profit.

§ 227. Grouping Orders.

Under the list-percentage plan—as also under other cost-finding plans—it is a common practice to divide orders into groups of more or less standard quantities. Thus an order for 1,000 units of some particular article may be divided into groups of 20, 100 or 500 each, the number in the group depending upon the size and style of the unit and the basis of obtaining costs, whether by weight, pieces, or dimensions. Such a plan not only minimizes clerical labor in the office but promotes efficiency in the works, the order number so grouped being more susceptible of ready division among a number of workmen, and the goods being more conveniently handled.

Also large orders embodied in one individual production order and covered by but one job follower, are apt to cause more or less confusion, as there is no clear line of demarcation for the adjustments that are easily possible when such a production order is subdivided into a number of smaller

* Dicksee, "Advanced Accounting," p. 236.

groups, each complete in itself. The smaller group order is particularly advantageous in cases where the number of units started in process is large but is subject to a reduction or partial cancellation in a following department.

Where, as required by the schedules, certain goods are to leave certain departments at specified times, it is almost essential that the quantities under each order be kept within small compass. Delays are at times unavoidable, but if the groups are small, any particular group can readily be "back ordered," whereas if the delayed article is part of a large group this is almost impossible and trouble and confusion usually ensue.

§ 228. Cost Analysis Sheet.

For all the varying grades and character of product involving a difference in production cost, there should be maintained a detailed cost record or cost analysis sheet similar in its general form to that shown in Figures 159-161, but modified to meet the needs of the individual plant. The descriptive portion of the form—shown in Figure 159—is, from the nature of its captions, more particularly fitted for factories producing agricultural implements, machinery, etc. Shoes, for example, would require entirely different descriptive headings.

This is readily seen when we consider that machinery may be made by independent "elements" each complete in itself, and that these elements where desirable may be made in advance for stock and later be assembled with other elements to form the complete machine. Shoes, on the other hand, have but one complete element—the uppers—which can be made ahead for stock. As a rule, therefore, shoes are not made up by stock elements, the modern plan being an efficiency method of putting through orders on what is called the "sheet system." Under this system a schedule is started each day with orders sufficient, if possible, to utilize in full

the capacity of the various departments through which it must pass. The dates on which such a schedule must leave the various departments are all determined in advance.

The cost analysis sheet, no matter what the product, should be so devised that the material and labor operations of each department stand out by themselves, segregated from those of other departments. When this is done and the sheet is used to record costing tests, the totals appearing on the form shown in Figure 160 may be used in the upper portion of the form shown in Figure 199 in which "process" (cost from preceding department) material, labor, and expense respectively are entered as elemental totals for each individual department whenever cost tests are compiled.

In the matter of shoes or other products similarly handled, the cost analysis sheet, instead of having the column captions "Operation No." as shown in Figure 160, may be modified so as to provide a column for each department in which will appear a printed list of its possible operations.

When the cost analysis sheet of Figures 159-161 is intended for use with agricultural implements or similarly handled lines, it will be found most convenient if made in sections, with each section punched for a loose-leaf binder. If these sections have fifty horizontal lines to the page, each section will represent fifty integrants. Therefore, if the machine or other article of product has two hundred integrants, it will take four sections to record the detailed cost of the entire machine or article.

Each of these cost analysis sheet sections is composed of a master sheet (Figure 159), with a short, or narrow sheet (Figure 160) for each two departments of the shop, one department appearing on each side of the short sheet or page. The master sheet shows the name of the element, the name of each integrant, the number of pieces of such integrants needed in the particular element, information as to where, if at all, the same integrant is or can be used in other ele-

ments of the same machine, and again on other machines, implements, or devices.

On the short department sheet (Figure 160), columns show the cost of semi-finished goods that have been made up ahead for stock designated as "Process"—meaning parts from a preceding department or a former order in the same department—also columns for "Raw Material" and "Expense." The columns across the sheet for listing the individual operations (by operation number) should be sufficient in number to accommodate all the successive operations on a given integrant under ordinary circumstances. If but a limited number of integrants have a large number of separate operations, then it were better to keep the size of the sheet down to reasonable proportions and allow two or more horizontal lines across the form for the use of each integrant. This can readily be done as the columns are not *headed* with the name of any operation, the operation in each case being shown by a symbol number in the column marked "Operation number." For the sake of brevity and convenience in recording, each labor operation in the plant should have a designating number which is used exclusively as the designation of that operation, both on the cost analysis sheet and elsewhere.

The series of columns on the last page of the cost analysis sheet (Figure 161), may be assigned one each for different operating departments, and in these the total departmental costs may be shown, thus step by step arriving at the entire cost of the article. There may also be columns for summarizing the cost of the article by production elements—material, labor, and diffused expense, irrespective of departments, the latter element showing also the averaged constant per man-hour in the several departments concerned.

As costs are presumably to be worked out on integrants and each integrant will therefore have its comparison sheet of possible cost fluctuation (Figure 199, upper portion), then the cost record (Figure 161) when wanted for fixing selling

prices, can be compiled by means of cost averages for each integrant taken from such comparison sheets, or it may be compiled entirely from cost tests (also recorded on Figure 161) as may be desired by the management. These detailed cost analyses can be maintained in comparative form for statistical purposes, and it is from these compilations that the arbitrary cost percentage (lower portion of Figure 199) may be accurately obtained—so accurately in fact that the term "arbitrary" becomes a misnomer.

§ 229. The Cost Summary.

For such products as canned goods, bottled goods, toilet soaps, prepared foods, etc., a form similar to that shown in Figures 171, 172 can be used for working out original estimates and recording subsequent costings, either on the specific cost-finding plan or under tests on the list-percentage plan. The use of such a form contemplates a separate sheet for each successive department, each specific order monopolizing a line horizontally across the sheet. The separate production elements are grouped by themselves, with a grand total at the extreme right. It is sometimes advisable to include a summarizing or total column for "Material," and also for "Labor" (not shown on Figure 172) in addition to the "Expense" column, particularly when the list-percentage plan is used and such totals are to be carried to a form similar to that shown in Figure 199.

It will be noticed that after every third costing record on the form shown in Figures 171, 172, a line is assigned for the record of the average of these three lots. Additional lines may be provided for similar averages of six lots, nine lots, twelve lots, etc., if desired. It must, however, be remembered that the real present costs are more closely perceived if the averages do not go far back in the past—a condition sometimes necessary when the establishment of a selling price depends on an average of costs extending over a con-

siderable period of time, as when costs vary at different seasons owing to differing climatic influences.

§ 230. Comparison of Cost Fluctuations.

Forms similar to the summary of costs shown in Figure 199 may be used for purposes of cost comparison. These are preferably handled on the loose-leaf plan, giving one page to each element or integrant on which costs are to be worked out and recorded. Columns may be provided on this form for dates, shop order numbers, cost of material, cost of labor, and diffused expense by totals, this data being taken from the Factory Order Register (Figures 38, 39).

Whenever cost tests are made, any fluctuations from the arbitrary figures may be shown on the cost record by percentages. Perhaps one-quarter or one-third of the distance from the bottom of the cost record (see Figure 191), lines may be reserved for the standard list percentages. These percentages will be changed from time to time as efficiency methods reduce the costs, or as they are varied by conditions.

The headings at the top of the cost record will apply to the portion of the sheet reserved for the standard percentages. A distinct line of demarcation should, however, be preserved between the standard percentage figures and the figures obtained from tests or specific costing. As has been said, the standard figures will vary to some extent as tests are made and the sheets therefore become valuable for disclosing any possible weaknesses that may exist—taking the place of a "peak chart" for graphically showing fluctuations.

§ 231. Controlling Accounts. The Factory Order Register.

A Factory Order Register similar in general effect to that shown in Figures 38, 39, is an important adjunct of the list-percentage plan. The illustration shows the form as a loose

sheet punched for a sectional post-binder. In practice, either a bound book or loose-leaf book may be used, as preferred.

When used in the form shown, the sheets, though "loose-leaf," are not separable in an accounting sense for the reason that considered from the binding edge, the last page of one sheet constitutes the left-hand side of a folio, which is completed by the first page of the succeeding sheet. The sheets are ruled on the left-hand side of the folio to show consecutive shop order numbers, quantity, size, and other related data concerning the product, while the right-hand side of the folio is devoted exclusively to the financial record. If desired, slip sheets with the financial ruling on both sides may be used for handling the financial record of several different departments. the master sheet containing all the physical data. In cases where the data varies in each succeeding department, it is preferable not to use slip sheets but to have full and complete data for each department, and particularly so when all product does not pass through all departments.

In use, each succeeding shop order or schedule is entered on the Factory Order Register. If a number of orders are put through in a group for percentage purposes, the group as a unit can bear the designating number. Under some circumstances, the items composing such a group need not be shown at all. If the Register is used more or less frequently to locate technical data concerning the product, then the specific data concerning each item of the group would better be shown, unless the same information is readily accessible elsewhere. It will, however, relieve the Register of detail if the group be used as the unit.

§ 232. Controlling Accounts. Debits.

When cost tests are made it is desirable that all items be entered on the Factory Order Register and also that a sufficient number of lines be assigned to the various items of the group to allow the collating of the cost data, which is

done in the columns headed "Charges." It is also a wise plan to include an entire "group" or "sheet" at one time, so that the possibility of "doctoring" the time or of any other tampering with the facts is reduced to the minimum if not entirely precluded.

The columns headed "Charges" are, as stated, used exclusively to collate the actual costs when a test is being put through, and no total is made of these columns as a whole. The only totals shown in these columns are those composed of several items charged against a specific order number. Such totals when found are, on a single entry plan, posted to the cost summary or record (Figures 171, 172, 199) for comparative purposes, as elsewhere described, but do not figure in the entries of the general books.

The actual charges for "Process," "Material," "Labor," and "Expense" are made to each department as a whole in individual ledger accounts maintained for that purpose. Charges against these accounts are made direct as material or labor is supplied or expense incurred, as per material requisition, pay roll, purchase analysis, or any other charge records. In entering charges to any of these several accounts, no cognizance is taken of the particular order number or numbers to which such material, labor, or expense is applicable, except only when tests are being made. In this case a memorandum is made on the proper records, but this does not disturb the course of procedure which these entries ordinarily follow, and which it may be said is not through the Factory Order Register.

To prevent misunderstanding it may be emphasized that where tests are made the actual charges against a given order number are shown in the Factory Order Register, but these entries are merely "memoranda" and play no part whatever in any trial balance of the books. They are used merely for a comparison between the actual costs which they reflect and the standard costs which are gauged by these actual costs.

The charges, for general accounting purposes, come on to the department ledgers or department accounts direct from the book or form of original entry and not through the Factory Order Register.

§ 233. Controlling Accounts. Credits.

The credit entries of the Factory Order Register are made as shop orders are finished in a given department, when the arbitrary or standard amount of credit may be passed to each of the elements of cost in its proper column in the Register; i. e., "Process," "Material," "Labor," and "Expense." At the end of the current month the credit entries for that month are totalled. These totals may be carried forward, page by page, through the successive pages of the Factory Order Register for that department as a cumulative total to form part of a grand total for each of the four columns, *or* the totals of each page may be handled as a unit and the totals thereon be carried to a summary sheet and there be treated as before.

Under either of these plans each individual total will be posted to the credit side of an account in the Factory Ledger bearing the same caption as the column from which such total is taken, the offsetting debit (consisting of the four credits embodied in one amount) being posted in the Factory Ledger to the Process Account of the next succeeding department. The entry may be made in the General Exhibit (see Ch. XXXIV) with each item of the entry appearing in the column (under Goods in Process) which serves as its synthetic or controlling account, as follows:

Process, Department C	$5,625.00	
Process, Department B		$3,125.00
Material, Department B		1,175.00
Labor, Department B		725.00
Expense, Department B		600.00
	$5,625.00	$5,625.00

Orders sometimes run over several successive months, either because of the amount of work required for their com-

pletion or because they are "side-tracked" for the sake of other work. In this latter case the transfer of the work in process involves an item of cost, which is sometimes a considerable one in factories where preference work is tolerated.

There should be no factory rule so rigid that it cannot be bent when the emergency requires. When, however, this is done in order to favor some special work, an additional charge should be made for the preferred service since an additional cost is *positively there*.

To provide for work running over several different months, the Factory Order Register (Figures 38, 39) is provided, with three footing lines to be separately used for the totals of as many different months. If all of the credit entries for the first month be made in black, the totals drawn down may also be black. If all of the credit entries of the second month be made with green ink, there will be no difficulty in drawing down the totals of these green-ink figures, as they are readily distinguishable from the black figures in the same column. In like manner, if all of the credit entries made in the third month or period be made with purple ink. this will distinguish them sharply from the entries for the other months in the same column and the totals may be drawn down without difficulty.

§ 234. Controlling Accounts. Variations of Balances.

It will readily be seen that as each Factory Ledger account has been debited on a positive basis from sources other than the Factory Order Register, and has been credited on a list-percentage standard basis from the Factory Order Register, there will be a variation as time proceeds. To adjust this variation, an inventory, as explained in § 235, should be taken at least three or four times each year, showing the physical condition of each departmental element represented by a ledger account.

This inventory will probably show that some accounts have overrun and others have underrun, and as such differences

are found they are charged or credited, as the case may be, to the reserve account for Variation of Weights and Measures, or to "Over, Short and Damage" as may be preferred, and be absorbed in manufacturing expense after the manner described in §§ 154-156. In cases where the difference between the inventory and the accounts is glaringly large, an investigation should be made as to the cause, which when found may be treated as the circumstances require.

More or less frequent tests on groups, or on individual production orders serve as safety indicators for the entire volume of orders in the various departments. The amount and percentages of differences in each departmental element (see Figure 200) show clearly and unmistakably any variations from the normal. Where frequent differences occur between standard and test costs, it is usually the result of some weakness or inefficiency which can be and usually is removed when attention has been called to it by the cost test.

As differences may exist one way and another in the various cost element accounts in the Factory Ledger, some proof of their accuracy is desirable. Such proof may be had by drawing off a list of the balances of each separate element in the various departments, and comparing the net total of these balances of each element with its synthetic or controlling account in the General Exhibit.

Thus, the total footings, both debit and credit, of the departmental material accounts in the Factory Ledger should agree with the same footings of the controlling account "Material" appearing in the General Exhibit. If this is the case, the accuracy of the Factory Ledger accounts is, presumptively, proved. Should either debit or credit footing not be in agreement with the controlling account, an error is indicated on the side of the ledger in which the discrepancy exists.

When the standard cost figures are found to vary from the actual costs as shown by tests, the standard figures may be corrected by means of inventory results. These inven-

tory results, when found, are applied to the standard cost figures of any particular product for a given period, each departmental element being scrutinized in its turn. By adding to or subtracting from the cost figures in proper proportion as the balances overrun or underrun, accurate production costs are secured and proved, and this without a large volume of clerical work.

§ 235. Departmental Inventories and Adjustments.

In taking an inventory of orders in work or "goods in process" by departmental cost elements, an inventory form similar to that shown in Figure 92 will be found convenient, using one or more sheets as may be necessary to properly enter the entire list of orders. It will be necessary to list these unfinished orders four times—one list for "Process" and one for each cost element. Thus the inventory sheets may show as follows:

Process (semi-finished goods from preceding departments)

Order No. 1080
Order No. 1081
Order No. 1082
etc.
} At amount charged in at.

Material

Order No. 1080
Order No. 1081
Order No. 1082
etc.
} Cost of material supplied to the various jobs up to the time of inventorying.

Labor

Order No. 1080
Order No. 1081
Order No. 1082
etc.
} Cost of labor performed on the various jobs up to the time of inventorying.

Expense

Order No. 1080
Order No. 1081
Order No. 1082
etc.
} Proper burden of expense to be levied against each job up to the time of inventorying.

As the various departmental accounts in the Factory Ledger have been severally charged with these same items, and in like manner have been severally given credit for product, there will ordinarily be a debit balance in each of the elemental accounts, representing the value of the several ele-

ments in the goods still in work. For this reason the inventory must be taken, not by the unit value of the article, but by its several constituent cost elements so that the total of each element as shown by the inventory, can be placed on a comparative basis with its corresponding Factory Ledger account. Thus in the case of a labor account, if there is not in work in a given department a sufficient volume of labor on partially finished product to match the amount of work represented by the corresponding Factory Ledger balance, the variation must be recorded in the adjustment column and be properly absorbed into the reserve account maintained for the purpose.

The same conditions obtain with material and with expense. The three elements of cost must be handled separately. They cannot be combined and be "matched up" with one inventory on a production unit basis without a departure from the very features which mark the usefulness of the present plan—i. e., the finding of costs by constituent production elements.

The "Process" accounts will very seldom need adjustment, because they receive both debits and credits upon the same basis of value, and there are therefore no differences save those arising from clerical inaccuracies.

In order to expedite inventory taking and also to reduce to the minimum the work ordinarily involved therein, it is a most excellent plan to have one or more departments inventoried each month, the same departments being again inventoried in their turn, perhaps three—certainly not more than four—months later. By thus covering some portion of the plant every month the inventory loses its terrors, fewer inaccuracies creep in, and the work as a rule is better done.

Also when the inventories are taken on predetermined dates, it gives the various department heads an opportunity to so arrange the work of their respective departments, cleaning up all work on hand as far as possible, that it will be in

the best possible condition for inventorying when the prescribed date arrives. A card of instructions based on departmental inventory dates is shown in Figure 95.

A special inventory man will be found most useful where many inventories are to be taken. Such a man will prepare for each inventory before its date arrives, and by proper arrangement of departmental work in co-ordination with the heads of departments, by supervising the inventorying while in progress and perhaps largely doing it himself, will so systematize and minimize the work that most of the usual interruption to business is avoided.

When not on inventory work the special inventory man or chief inventory clerk can usually be of much service on the records which pertain more particularly to material. Also, if personally capable he is in a position to take charge of almost any line of efficiency promotion.

In plants where it is feasible to take an approximate inventory of goods in process on the first of each month, an inventory form similar to that shown in Figures 87, 88 can be used in connection with the form shown in Figure 200, "Comparison of Fixed Percentages." One sheet of this latter form may be maintained for each cost element in each department in connection with the Factory Ledger account of corresponding caption. One line will suffice for each month or period. The debits of this form reflect positive facts. There are from time to time credit items also made on a positive basis, as for instance, where work has been done for other departments or for repair parts, and actual time, material, and expense burden costs kept for this work. In such case the total of all such items will be shown under the column headed "Credits—at Actual Cost."

Under the "At Fixed Cost" caption may be shown the sum of all the list-percentage amounts for the month. In the "Inventories" column, if it be an inventory time, the amount can be put under the "Physical Count" column; whereas if

it be an interim month the "paper inventory" can be shown under "Approximate" column.

As the Factory Ledger balance will be accessible, this balance can be entered direct, and any difference between it and the inventory is recorded in the "Difference This Month" column; also proper entry will be made in the "Difference to Date" column. If it be an inventorying period, the difference will be written off to the Variation of Weights and Measures, or the Over, Short and Damage Account, through means of an inventory form similar to that shown in Figure 92. If it be an interim period the difference will merely be recorded and possibly reported to the person directly concerned.

If after the inventory of any departmental production element has been considered on the credit side of its corresponding Factory Ledger account, there is a credit excess, it will indicate that the orders have been figured on the inside, which is also the safe side; i. e., that they have been credited to the department at a sufficiently high cost to more than cover the total actual charges to the several elemental accounts. There will be an excess debit balance on the Factory Ledger account at inventory time if the credits for orders finished in the department have not been sufficiently high. When this is the case the percentages for the following month may be adjusted if it seems advisable.

When inventories such as that contemplated by Form 92, show the value of material in any store-room, or the value of any departmental cost element on hand to be more than its record value, the difference will be entered in the adjustment group under the column headed "Over." If the actual value is less than the record value, the difference will be entered in the "Short" column. Each commodity or schedule is treated on a line by itself, and where the stock-room record is kept by different kinds, grades, sizes, or other specifications, the individual items of the record are adjusted to agree with the facts.

In the case of schedules or production orders, on the other hand, the various departmental cost elements have to be taken as a whole for the reason that specific charges have not been made against the various schedules or production orders in process as such, but have been made against the cost elemental accounts. Individual stock accounts and departmental accounts may be given debit or credit as necessary, the posting being taken from the inventory sheets. The controlling entry will be made from the totals of the adjustment group on these same inventory sheets. If the net balance is "Over," it will be credited to the reserve account for Over, Short and Damage. If it be a "Short" balance, it will be charged to the debit side of the same account.

As a precautionary measure, each month an arbitrary amount—determined by the nature of the business and past experience—is credited to the Over, Short and Damage Account in the reserves and charged to the manufacturing expense of the business. This should make a sufficient provision for any waste, leakage, weaknesses, or underestimating of values in factory operations. Waste and shortage should, of course, be overcome as far as possible, but sufficient provision should be made to safely cover a reasonable amount of loss from these causes.

When a second inventory is taken it will not be necessary to write up a second sheet, since the original sheet may take the place of a master sheet and a properly ruled slip sheet be used in connection with it.

CHAPTER XXII.

THE MACHINE-HOUR PLAN.

DETERMINING INSTALLATION AND MAINTENANCE COSTS.

§ 236. The Machine Hour.

As graphically described by Mr. Church, the machine-hour plan is a method of distributing manufacturing costs "through the point of the tool." Perhaps more accurately, the method is described as the distribution of manufacturing costs "through the machine," since the method is applicable to mechanisms such as looms, printing presses, annealing furnaces, cranes and the like, which are lacking in point.

Under the machine-hour plan, rent, light, heat, power, and the hundred and one other items that go to make up the usual overhead expense, become for the most part direct expense, charged in proper proportion to each machine or group of machines, the total affording a basis for a proper machine-hour charge. This charge is "loaded" on the product of the machine or group of machines, according to the number of hours such product monopolizes the services of such machine or any one or more of a group of machines. In other words, the expense applicable to a machine product is charged to it by means of an hourly rate for the use of the machine.

There would seem to be no reason why all expense should not be charged through the machine hour and the author prefers to do so, but, nevertheless, as stated by Mr. Church, after everything that can be charged as direct expense is exhausted, the small remainder of indirect expense, together with

lost time, etc., may, if desired, be distributed as a supplementary rate.

The machine-hour plan of cost finding has a wide range, but before its adoption in any particular case a careful study of conditions should be made. Where properly applicable, the machine-hour plan is undoubtedly the most accurate, and, once installed, the simplest method of cost finding. The difficulty lies mainly in its first installation—in the determination of the exact proportion of the various expenses which may be fairly charged to each particular machine or group of machines composing the unit.

§ 237. Preliminary Work.

In order to obtain accurate results in cost finding by the machine-hour method, the preliminary work must be particularly careful. There are many difficult problems to be solved and unless these are solved properly and accurately, the whole fabric will be weak.

In determining the cost to be charged to each machine or group of machines, complete uniformity of practice does not obtain, as matters of detail will naturally be viewed from different standpoints by different individuals. As long, however, as the sum of the parts equals the whole in the distribution of expense, the system will at least work harmoniously, and if an accurate record is kept of the original figures used in arriving at the installation costs, these can be readjusted from time to time as dictated by conditions.

Under the machine-hour plan the unit need not necessarily be the individual machine. Groups of kindred machines may be brought into so-called "industrial centers," and these groups treated as units. Where all machines are practically alike, divisions of the department need not be made at all, the entire department being considered a unit. Where this is not advisable on account of the large number of machines in departments, as in the case of the spinning, weaving, and knitting

industries, the division may be arbitrary, or may be determined by environment, or may be based on the classes of product.

When machines are grouped in this way the hourly rate is applied to the output of the industrial center, group, or division.

§ 238. Individual Machine Records.

Under the machine-hour plan, as stated, each machine or group of machines is treated as a unit, and all the costs applicable to the operation of that machine or group is charged to it individually. This necessitates an individual record for each machine. To facilitate this and as a convenient method of identifying the different machines for general purposes, each should bear an inventory number or other designating number fastened to it in a conspicuous place.

Forms for individual machine records are shown in Figures 178, 179 and 189. The form shown in Figure 189 will be found convenient. On it space is provided for recording the name of the maker of the machine, the date of its purchase, the factory number, the price paid, and other relevant data. Space is also provided for recording the same information in regard to its individual motor, where used. The motor record also provides for entry of the motor horse power, kilowatts, volts, and revolutions per minute. Any other equipment, such as air hoists, oil or gas forges, etc., used exclusively with the particular machine, is also to be entered on its record sheet.

In the column for determining installation costs are found the following items:

Value of Machine
Value of Motor
Value of Shafting
Value of Supplies
Total Investment
Interest on Investment

The value of the machine is based on the original purchase invoice, or otherwise is taken from an inventory or appraisement. The value of the motor, shafting, and supplies (special tools or other equipment not included in the value of the machine) is determined in the same manner. A total is then drawn and the annual interest on the investment is computed and entered on the record. This interest entry usually constitutes the first item of cost to be considered and is perhaps the easiest of determination.

§ 239. Repairs and Depreciation.*

For each individual machine an annual reserve rate must be made for repairs. If there is an accurate record of repair costs actually incurred in the past, it will afford a basis of expectancy as to the possibilities of the future. The age of the machine and the uses to which it is put bear directly upon the amount to be reserved each year against repair charges. Reservations or allowances for repairs are, however, at the best but little more than guesses. Whatever the basis of the system, it is much better to place the amount high enough to cover all possible contingencies than to place it too low. An over-reservation, if not excessive, can do but little harm. An under-reservation may be seriously misleading.

On the machine record (Figure 189) space is provided for the record of actual repair charges and also space for recording the annual reserves, so that in close proximity a chronological record is kept of the successive estimates and of the related facts.

A reserve for depreciation is equally as important as a reserve for repairs. Objections are sometimes raised to reserves of this nature. Frequently this is because those in charge desire to make the best possible present showing of profits regardless of the future. Or sometimes such objections are based on the claim that repairs and maintenance having

* See Ch. XIV, "Maintenance and Depreciation," for a more complete consideration of this subject.

been charged to revenue, and the effectiveness of the assets having been maintained, these assets are now as valuable as when first acquired. This is specious reasoning, but nothing more, for no matter how large the expenditures for repairs and maintenance, the time must come when these assets have outlived their usefulness and will require replacement in their entirety.

The amount to be reserved for depreciation is largely a matter of estimate and intelligent guessing, but with the wonderful improvements being made in machinery from year to year, it is wise to depreciate liberally. Such depreciation should not only be against the natural life of the machine—which can be estimated with reasonable fairness—but against obsolescence—the time when the particular type of machine will be so far outclassed by more effective mechanisms as to make its continued operation economically impossible. It is easy to conceive of conditions which might necessitate an entire replacement of the operating mechanisms of a plant within a few years of their installation, and while such short-term replacements are not usual or to be anticipated, such liberal provision for depreciation should be made that when an early replacement is necessary it will not be totally unprovided against.

"Allowing the property to wear out without provision for replacement, can be good business policy under only one condition, namely, if the business, or that department of it, is to be abandoned. In such a case policy requires full benefit to be got from the plant without large cost for renewal and repairs. The property must be exhausted as thoroughly as possible. An easy method of treating depreciation under such a condition would be to distribute to stockholders all net receipts. * * * If the capital was originally wisely invested and has been properly employed, the stockholders will ultimately receive back their original investment in the final wind-

ing-up of affairs; for if the business could have replaced the worn-out plant—as it could if prosperous—it can pay the stockholders as much as replacement would cost, which is, of course, practically the original capital. * * * Careful accounting should show that a part of each dividend of this sort is not earnings, but is simply capital returned because the business has no further use for it."*

§ 240. The Annual Charge.

The items of cost already discussed, up to and including depreciation, are footed and the total constitutes the total annual charge. This represents the installation costs, so called, and these costs, with the exception of repairs, continue to accrue whether the machine is used or is allowed to remain absolutely idle. Even the repair charges of an idle machine are partially absorbed, at least, in keeping the machine in a proper condition of cleanliness and protected from atmospheric conditions.

It must be borne in mind that it is *not* necessary to make monthly or periodical charges of any kind to individual machine accounts or monthly or periodical apportionments of annual charges, since these have already been calculated in the costs of the individual machine. *One total charge* each month or period to the Factory Ledger controlling account "Machine Time," will suffice for the apportionment of the annual charges to the controlling account.

Besides the total charge to the Factory Ledger account "Machine Time" each month or period, there is also to be considered, as hereinafter described, the "Term Charges" which include the cost of labor, power, machine repairs, and depreciation, and also the expense burden. The monthly or periodical apportionment of annual charges and of these term charges, go to make up the total charge against "Machine Time" account.

* Cole, "Accounts, Their Construction and Interpretation," p. 80.

The credits to the Machine Time Account come from the totals of the various time reports of machine time used, as more fully explained in § 276. Any balance in this account, be it a debit or a credit, is of the nature of a barometer, or, more specifically, is an efficiency gauge, showing the performance of the department, the division, or the entire plant as a whole.

CHAPTER XXIII.

THE MACHINE-HOUR PLAN (Continued).

MACHINE OPERATING COSTS.

§ 241. Operating Costs.

The operating or term costs of a machine consist primarily of items having to do with the actual use of the machine after its installation. Unlike the annual charges, which are to a certain extent fixed, the operating costs vary with the time the individual machine is in operation, and to properly collate such costs a special cost compiling record must be maintained for each machine.

This form, called a "Term Cost Record," is shown in Figure 191. It can be made up in slip sheet form, all the data concerning the individual machine preceding the columns of Figure 191, appearing on the master sheet alone. Slip sheets with the proper column ruling are then inserted each month or period, thereby avoiding the transcription of the machine numbers and descriptive matter each month. The master sheet and slip sheets are identical save only for the additional matter on the master sheet. The segregating columns of the term cost record are as follows:

(1) Total Term Charges
(2) Labor
(3) Chargeable or Productive Hours
(4) Power Units
(5) Power Cost
(6) Compressed Air Units
(7) Compressed Air Cost
(8) Gas or Oil Units

(9) Fuel Cost
(10) Diffusion of Expense
(11) Diffusion of General Machines
(12) Credits to Diffused Machines

§ 242. Total Term Charges.

In this column are recorded the totals of all the items on the sheet against a given machine number or group number—i. e., the totals of the various columns from two to eleven, inclusive. This grand total is charged to the controlling Factory Ledger account, "Machine Time."

In cases where the machines are treated in industrial centers, divisions, or entire departments, the term cost record need not be used, as in such case a form similar to that shown in Figure 180, providing for the entry of both annual and term charges, will be found more convenient. The term cost record shown in Figure 191 is designed more specifically for use where costs are desired on individual machines or small groups.

§ 243. Labor.

Each machine is charged with the cost of its operator, and his assistants, if any. In cases where several machines have but one operator in common, either the several machines are included in one group or industrial center, or if the costs of the different machines, outside of labor, are unequal or disproportionate, then the operator's time is divided among them on any equitable basis. Such a division is desirable in the case of automatic machinery of different types each having its individual operating cost. In cases where labor is to be divided among different machines, it is oftentimes possible to accurately record the time spent on each machine—particularly such time as is consumed in setting up or making ready—and this gives an absolute labor charge.

Almost any desired system of time reporting that will show accurately the starting and stopping time on jobs can

be used to good advantage in the machine-hour plan. Starting and stopping time is essential as a basis for charging the machine time. It is also essential that idle time be reported, the cause being indicated for efficiency purposes.

Some record subsidiary to the term cost record must be used to summarize the labor reports. The nature of the record used will depend entirely upon the form of time report employed. Whatever may be the form or nature of the labor records, they are first used to compute the employees' earned pay, after which they may be handled in any way desired to apply the charge to the proper individual machine or group of machines.

Where a piece-work coupon plan is used and such coupons are pasted upon a prepared sheet or sheets, then the totals can be inserted in the term cost record. Where the time report is similar to that shown in Figure 123, then the total is arrived at by use of a collating form similar to that shown in Figure 179. Where individual job cards are used, a wide-carriage listing and adding machine may be used to much advantage, particularly if equipped so as to list job numbers, the hours and minutes employed, and the money values involved. Such listing can be done on large down-ruled sheets, to be kept in a binder as permanent records. When the time cards for each machine are listed and totalled, the labor cost and the number of chargeable or productive hours may be transferred to the term cost record, each total being entered opposite the number of the machine to which it applies.

§ 244. Chargeable or Productive Hours.

The chargeable hours of the term cost record (Figure 191) are the total number of hours that the particular machine opposite which the items are entered, is used on specific work. That is to say, in individual cases, it is the elapsed time in hours and minutes from the time the operator begins the preparation of a machine for a certain job up to the time the job is, as to

that machine, finished and the machine returned to normal condition, excluding all time spent on cleaning, repairing, and shut-downs from causes not incident to the individual job. The chargeable time will be summarized as described in § 216, and the total appearing in the chargeable time column will be used as a basis for allocating power costs and overhead charges, and will also be used in compiling efficiency statistics concerning the individual machine or group.

§ 245. Power Units.

In determining the cost of operating a given machine or group of machines, it is necessary to make tests in order to arrive at proper power charges. The nature of these tests depends entirely upon the character of the machine and the general classification under which it comes, whether a machine tool, mixer, loom, spinning frame, hydraulic press, pneumatic hammer, etc. Such tests are primarily the function of the mechanical engineer in so far as volume or quantity of power consumed is concerned; yet as a broad proposition it devolves upon an accountant to "count the cost."

Under ordinary circumstances the "setting-up" or "make-ready" time will average well among machines of a given class. Hence it does not seem necessary to go to the extreme method of applying the power charge only to actual running time, though theoretically this should be so. As a matter of fact, a machine is not running the entire time that the job card or record shows it to be in use on a given job. It has been monopolized by the work, but power is consumed only when the machine is in active operation. Hence, power should only be charged for the active operating time.

In practice, however, no such fine discrimination is necessary. Even though the machine is not operating for part of its reported time, the power for its operation is necessarily at hand, and whether this power be used or not for the time consumed in preparation, does not to any great extent disturb

the actual power cost. Likewise, the "setting-up" time for machines of a similar class is nearly the same. Hence, a charge on the basis of time employed, regardless of whether this is actual operating time or not, works no distortion of the distributed cost.

Where two sets of time records are desired—i. e., one record for the machine while in the setting-up or preparatory stage and one for the machine while in motion—such records are readily made. The author does not, however, advise this multiplication of records except in cases where extreme accuracy of result is desired and where power is purchased either in the form of electric current or steam, its exact cost being therefore easily determinable.

When the power consumption has been determined after one or another of the plans set forth in §§ 141-146, it should be recorded on a form similar to that shown in Figure 189. A similar record may also be made on the master sheet of the term cost record shown in Figure 191, so as to be conveniently at hand for use each month or period in ascertaining the number of units chargeable to each machine. The method of determining the power units consumed is to multiply the power unit rate of each individual machine or group by the number of productive or chargeable hours as shown in "Chargeable Hours" column of the term cost record, setting down the result in "Power Units" column of the same form.

The process or operation of determining the power applicable to individual machines is performed but once unless physical conditions change, when as a matter of course a new test becomes necessary. Ordinarily, the correct basis once determined, may be used from month to month without change.

§ 246. Power Cost.

The power units having been determined for each individual machine or group, column four of the term cost record—"Power Units"—will be footed and the total number of units

be divided into the total power cost assessed against the section or other subdivision of the department in which the particular machines happen to be located. The result, known as the power constant, is used in each individual case in connection with the power units, one multiplied by the other giving the power cost, which is entered in the "Power Cost" column.

The power units of all machines driven by a given engine or motor should all be included in one total so as to arrive at the power unit of that engine or motor. This applies even in cases where one large engine drives all the machinery in the plant. Such a plan is more accurate than dividing the power first as between the separate departments and then subdividing among the various machines.

Whatever the plan used or whatever the number of power centers, each center should be the basis for determining the power constant within the scope of its own usefulness. As the sum of the parts must equal the whole, so for that month or period the sum total of power costs charged against the various machines must just equal the cost of the power center by which such machines are driven.

In the case of hydraulic machinery a column for water cost can be supplied in the term cost record. The water cost may be determined by meter. If more than one machine uses water power, meters can be made the basis for dividing the cost of water consumption between the several devices which draw their supply through the common "onemeter."

§ 247. Compressed Air. Fuel.

The four next items of the term cost record—(6) Compressed Air Units; (7) Compressed Air Cost; (8) Gas or Oil Units; (9) Fuel Cost—if used at all, are handled in the same manner as power units and power cost. In the case of fuel cost, where coal, coke, or oil in containers, is burned, it may be necessary to tabulate requisitions or other forms of stores reports. This is done in any desired simple method and the total of such tabulation set down in the term cost record.

§ 248. Diffusion of Expense.

A close and careful record is kept of departmental costs. This record includes the usual manufacturing expense items, save those already considered under annual charges. The distribution of this expense over machines is most readily and accurately effected on the man-hour basis, as discussed in §§ 98, 192, and 193. This man-hour is, under the machine-hour plan, based on the time devoted by the attendants to their machines.

The expense costs which cannot be laid on the individual machine through the annual charge, do not from their very nature fall heavily on automatic and semi-automatic machinery. A consideration of such items will undoubtedly show that their distribution on the man-hour basis gets nearer the truth than does a distribution on the percentage basis. The effect of the latter plan when labor is used as a basis, is to give the highest burden to the machine with the highest paid operator, and the lowest burden to the machine with the lowest paid operator, when, as a matter of fact, the burden of expense properly chargeable to a certain machine is usually not affected in any way by the amount paid its operator.

Nor is the burden of expense laid on machines with greater accuracy through the cost of material, since the overhead costs, aside from interest on goods in process, are no more nor less in the manufacture of brass as against the same operations on cast iron; on cotton yarn as against similar operations on silk; on news ink as against a costly carmine ink. A pound of steel may be made into bolts and require very little time and machine work, or it may be made up into thousands of extremely minute hair springs and require many hours of treatment, and on the basis of material the burden of expense is the same in either case. A percentage on labor cost would meet such a situation more nearly than a percentage on material cost, but in neither case is it adequate. The element

of time as introduced by the man-hour plan comes nearest of all.

§ 249. Diffusion of Expense on Man-Hour Basis.

The author strongly advocates the man-hour basis for diffusion of indirect expense, operated as follows:

In each department in which the machine hour is used on product, all of the overhead costs not already considered are grouped together in one amount. The summary sheet illustrated in Figure 180 will be found convenient for the purpose. The total indirect cost for each department is then divided by the total number of productive hours—the total number of hours of labor given to productive work—in that department for the month or period under review. This gives the amount to be charged against each productive hour—i. e., the man-hour constant. This is charged against each machine or group on the basis of the number of hours of labor given it by its attendants in the period under consideration. Thus, if a machine requires two men to operate it, and the labor of each for the period of four weeks amounts to 220 hours, the machine is charged for 440 times the man-hour constant as its share of overhead costs for the four-weeks' period.

If one man operates two machines alternately, the expense burden laid on each of these machines is in accordance with the number of hours' attention it receives from the operator. In cases where one operator watches two or more automatic machines simultaneously, the expense burden is equitably divided among the machines which receive his attention.

The number of hours to be charged against each machine is taken from column 3 of the cost record shown in Figure 191, save in the case of automatic or semi-automatic machines. In the case of such machines another column must be inserted between columns 9 and 10 to indicate the number of hours of operator's attendance, column 3 being left to represent the number of hours the machine is employed on productive orders.

§ 250. General Machines.

In the cases of some machines it is impractical or is a physical impossibility to charge their operating costs directly against order numbers, as for instance in the case of a tool-grinding machine, which sharpens the tools for a number of direct-producing machines. Such machines are known and treated as "general machines." Their costs are determined just as costs are determined for other machines, but under the machine-hour method these costs are spread over the individual machines which are served; or in some cases the costs are merely divided equitably between the departments benefited. In the former case the costs become a part of a controlling classification known as "Machine Time," and in the latter case become a part of the departmental burden, and are distributed as such.

In some cases where machines theoretically belong to the machine-hour or direct-producing class, a hardship is worked if their full time is reported against individual order numbers. For instance, a punch may be employed four hours on a job order that should take but two hours, the loss of time being occasioned by the many interrupting calls made upon the punch and its operator. These interruptions may be due to little jobs taking but a few minutes each but which must be done when needed, and if not done then, one or more men are kept idle. These short jobs cannot always be planned for ahead or for any definite time so as to avoid interferences. Under such circumstances, it is not feasible to charge punch costs against each of these small jobs, and the cost card for the punch cannot be accurately kept. The best plan in such cases is to treat the entire operating cost of the machine and operator as a part of, or the same as the overhead expense or burden of the department.

In cases where a device serves two departments, the cost may be spread between the two arbitrarily on a basis of the

average time given to each department or on any other equitable basis which will fit the local conditions.

In large machine shops there are usually large shears which work on specific order numbers, and there may be others in various parts of the plant which are for use as needed in short, quickly executed jobs, some of which may not take over three minutes. The operating cost of these latter shears is best included in the departmental burden.

The usual work of the travelling crane is of too intermittent and varying a nature to be charged on the basis of active time, or to specific order numbers. Some days it may be in constant motion. Again, on other days it may be idle more than half the time. Its services on a special order number may be performed in a few minutes, or may take half a day. There is no general rule for the application of such costs. The conditions surrounding the individual mechanism must be studied and its cost be distributed with due regard to equity and the economic possibilities.

In some cases the travelling crane is treated as a departmental expense, while in other cases where it serves certain individual machines, the cost of maintenance is spread over the machines served, the service rendered being closely recorded over a given period, so as to give a fair basis of apportionment. Thereafter it is occasionally checked in the same manner. In determining the percentage of crane cost against each machine served, the character and weight of the load is to be considered, as well as the length of time the crane is in use, since the service for some machines involves continuously heavy work while for other machines the loads are lighter and much more easily handled.

Where two or more machines are operated in a group by the same operator, the use of one machine following another, as for instance a rolling shears and a flanger, then the two or more may be included in one group; i. e., that particular shears being used almost exclusively on work which will go

to the particular flanger, can be grouped with the flanger for cost-keeping purposes. Then when the operator or operators start a job on the shears, they do not ring off on that job until the work has been passed through the flanger, the two machines being treated as one.

The same idea is sometimes applied in the case of cranes used for individual machines. A crane and its air hoist serving one machine is, both theoretically and practically, for cost-keeping purposes, a part of the machine which it serves. Accordingly, under such circumstances figures applicable to the crane are included on the machine record of the machine it serves. Frequently such cranes are included in the same inventory group number. Where, however, cranes serve two or more machines they are, as stated, treated individually and the cost is divided between the machines served.

§ 251. Diffusion of General Machines.

With the cost worked out on each general machine, it becomes a simple matter to spread such cost over other machines. In the act of distributing the cost, each individual general machine is taken in turn, and on its own line on the term cost record the combined amount of the annual and term charges of the given machine for the period under review is entered in column 12. Thus the general costs of machines 4, 5, and 6 summarized are as follows:

Machine No.	Annual Charge	Term Charge	Total Cost
4	2	6	8
5	2	3	5
6	3	5	8
	7	14	21

These are general machines to be diffused over directly productive machines numbered 1, 2, and 3 on the section of

the term cost record which follows. This term cost record also shows machines 4, 5, and 6 duly entered. The total term costs are shown in column 1. As explained in § 240, the annual costs are not shown, but for machines 4, 5, and 6—which are to be diffused—are respectively 2, 2, and 3, giving the respective total costs 8, 5, and 8 as set down in column 12 in the portion of the term cost record sheet shown.

Machines No.	Term Costs			Diffused Machines	
	Column 1 Total	Column 2 Labor	Column 5 Power	Column 11 Charges	Column 12 Credits
1	13	5	2	2 4	
2	14	4	2	6 2	
3	20	8	5	7	
4	6	4	2		8
5	3	2	1		5
6	5	3	2		8
	61	26	14	21	21
				26	
				14	
				61	

Machine No. 4 with its total term and annual charges of 8, is spread over machines 1 and 2 in column 11, first sub-column, on a basis of 25% and 75% respectively. The combined costs of machines 5 and 6 are diffused over machines 1, 2, and 3 in the second sub-column of column 11, on a basis of hours of productive labor, the hours not being shown on the term cost record.

All the general mechanisms to be distributed over direct producing machines, will be handled in like manner, the cost going to the varying machines benefited. In the count of items the debit items will largely overbalance the credit items, but the totals of columns 11 and 12 must exactly balance—a safety check which is the main reason for the use of the two columns.

The total of column 1 must, of course, exactly equal the items of columns 2, 5, and 11, and is charged to the controlling Factory Ledger account called "Machine Time," the off-setting credit being passed to or absorbed by costs of labor, power, and machine time. The actual entry may or may not pass credit to the Machine Time Account for the charges of column 11, as the accountant may see fit. If he prefers he may deduct the footing—21—of column 11 from the total charge—61—of column 1, the entry then reading:

Machine Time 40
    Productive Labor 26
    Power Costs 14

or posting all footings he may make his entry read:

Machine Time 61
    Productive Labor 26
    Power Costs 14
    Machine Time 21

The author prefers the former method inasmuch as by it only the actual chargeable machine cost is shown in the Machine Time Account. Under the latter plan the items of column 1 for machines 4, 5, and 6 have no real place there, because they are included in column 11 in the cost of machines 1, 2, and 3. The proportion of annual charges belonging to machines 4, 5, and 6 are also included, all of which if entered make fictitious figures, detracting from the statistical value of the work.

The cost of maintaining switch engines, self-propelling transfer cars, electric hoists, etc., etc., can be handled in the same manner as the cost of general machines, if so desired, being spread over the plant by means of such equitable method as is best suited to the needs of the particular case.

Where a yardmaster's record is maintained, showing the employment of cars, it is sometimes a simple matter to segregate the cost by direct charges. If this is too burdensome or top-heavy, the cost may be distributed equitably by means of

tests. These tests are taken periodically, an accurate account being kept for perhaps a week at a time of services rendered to each of the various departments and a fair basis being thus arrived at for an arbitrary division of the costs. Naturally some portion of such expense is properly chargeable against commercial costs. Usually the major portion falls upon the stores department, although in some plants the passage of heavy material from one department to another is a very large item. The conditions in each individual case must be considered specifically.*

* See Ch. XV, for a full consideration of this subject.

CHAPTER XXIV.

THE MACHINE-HOUR PLAN (Continued).

THE MACHINE RATE.

§ 252. Irregular Use of Machines.

The usual factors to be taken into account in fixing the machine rate are the annual charges and the term charges which have already been discussed (Chs. XXII, XXIII). Beyond these, other factors sometimes enter in. Thus, in many factories there are machines which were purchased with the full knowledge and expectation that they would not be operated continuously—machines for specific purposes which in some instances may not be used more than twenty-five times in a year. Such intermittent use entails unavoidably a high machine rate. Again, machines of large dimension capacity are frequently used for part of the time on smaller work than that for which they were designed, this being done in order to keep the machine in operation, or perhaps to save the cost of buying a smaller device of similar nature. Such use also entails a high machine rate, although the average cost per hour is undoubtedly less than it would be if the machine were idle instead of operating on small work. The smaller work must, however, bear the penalty of a high rate since the operating cost is not materially less on small work than on the larger work.

§ 253. Fixing Machine Rate.

A liberal machine rate is usually a wise policy. The manufacturer who attempts to increase his profits by fixing

his rate per hour for individual machine time too low, does not, of course, reduce the actual cost in any way, his effort only serving to build up a deficit on the cost records which ultimately may be materially harmful. The estimates of cost should be accurate. The past performance of the particular machine should be carefully reviewed and its amount of probable active use per year be based upon this performance. The management or cost accountant can then match up the cost maintenance and operation for one month or period with the apportionment of probable active hours for the same period, and thus determine a fair and just rate per hour. If the estimate or guess is a good one, then the work put through the machine for the period will exactly absorb the allowed cost for that period.

If the efficiency of the machine can be raised this does not mean that the machine-hour cost is diminished. If the volume of work in a given number of hours is increased, the machine-hour cost remains the same. It is spread over a larger number of units, thus reducing the cost per unit, but the cost per machine hour is not reduced. On the contrary, additional power consumed, or a more rapid deterioration, or other causes incident to the more rapid operation, may slightly increase the machine-hour cost. Broadly speaking, the only thing that will materially affect the machine rate is an increase in the number of hours of use, and this is not always controlled by the management but is quite often controlled by commercial conditions.

Where a "filler" is resorted to for keeping machines busy during otherwise idle seasons, such work participates in the regular machine rate, as otherwise the rate on regular work must be higher than it should be, or the rate of "filler" work be less than it should be. There should not be two rates for the same machine unless the operating and maintenance costs are actually less at one time than another.

§ 254. Applying the Machine Rate.

The machine rate having once been determined, the total number of chargeable hours of the machine at its regular rate per hour are charged to the individual order numbers to which the services of the particular machine have been given. The grand total of such chargeable hours and their money values are treated in the synthetical or controlling accounts as follows:

Goods in Process	24000 hrs.	$18,755.10	
Machine Time	24000 hrs.		$18,755.10

The total amount of credit for the month or period for each individual machine will be posted to the machine record (Figure 189). The costs having also been posted on the debit side of the same account, there will appear in regular ledger form the total debits and credits to the individual machine—the resulting balance one way or another showing, as time proceeds, the variation of performance from plan. This is not always true, however, as certain seasons may be known in advance to have idle time during which costs will accrue to be absorbed in busy seasons, and the accumulating debit balance then merely represents the happening of the expected.

§ 255. Trial Balance of Machine Records.

The controlling account "Machine Time" will almost always present a slight difference or variation between actual cost and estimated cost. This variation may be on either side and under ordinary circumstances should not be large. The balance of Machine Time Account will, together with the trial balance of the machine records, present a sharp, concise reflection of the actual conditions.

The trial balance of the machine records must, of course, agree with the controlling account "Machine Time" balance, balancing if it balances, or varying as it varies. When the Machine Time Account does not balance, this variation may be due to balance variations on a number of the machine records.

CHAPTER XXV.

THE MACHINE-HOUR PLAN (Continued).

THE SUPPLEMENTARY RATE.

§ 256. Overhead Expense.

Under the machine hour, the usual expense items, including rent or expenses of maintaining building, charges for power, for heat, light, labor, etc., etc., are charged directly through the individual machines to which they properly belong, as far as equitably possible. Beyond these, there are certain items of general expense which occupy the position of the usual "overhead expense" and when not charged through the machines are included in a "supplementary rate." There are other items which also go to make up the supplementary rate which will be discussed later.

§ 257. Efficiency.

For accurate cost-keeping under the machine-hour method, a standard of efficiency must be determined for each machine. The determination is a difficult one. What constitutes 100% of efficiency—the highest output of the machine under ideal conditions—and what portion of this is the maximum efficiency of the machine under existing conditions, and may not today's maximum efficiency be attained or even exceeded six months hence by means of improved conditions and better methods?

Conditions vary so that it is not possible to formulate any fixed rules for the determination of machine efficiency. Precisely parallel conditions do not exist in different factories,

and the method of determination that may fit one plant may be absolutely wrong in both theory and practice in another seemingly similar plant. The conditions of each plant must, therefore, be analyzed. Tests must be made and the efficiency of each machine be determined in the light of the information so obtained.

The maximum efficiency of the individual machine in its own environment having once been determined, the records thereafter will show any variations above or below this standard and afford the best possible basis for effective efficiency work.

§ 258. Efficiency Variations and the Supplementary Rate.

In determining machine efficiency the maximum output possible under existing conditions is usually rated at 100%. In practice the output naturally falls below this established maximum efficiency. Various familiar causes are responsible for such variation, such as slow workmen, delays on account of accidents, shut-downs for lack of material or for lack of work, etc., etc. Whatever the cause, the difference between the attained efficiency and the maximum efficiency constitutes a loss and a serious loss, of which account must be taken. Under the machine-hour method this loss may be diffused through the supplementary rate. The individual machine is already responsible for 100% efficiency, and any loss from wasted capacity, whether due to a failure to reach full production, or a failure to operate at all, as in the case of idle time or a shut-down, is obsorbed through the supplementary rate.

As to the nature of this loss there is not entire agreement. Mr. Church* does not regard it as a cost at all. Referring to lost time, which is but one form of efficiency failure, he says: "It is even somewhat questionable whether any imperative necessity exists to express this waste as an element

* "Production Factors," p. 121.

of the cost of jobs at all. Strictly speaking it is no part of such cost. If, for example, only half the machines in a shop are working, half the resources of the shop, roughly speaking, are being wasted. Under any percentage system the incidence of indirect charges on the work actually going through would be, roughly, doubled. On the production-factor plan the incidence at the tool point on the work actually going through, would remain unchanged, but the balance of wasted resources would be known as a separate amount and expressed as a *separate* percentage of the normal cost, if desired. * * *

"In practical working this is effected by what is termed a 'supplementary rate.' The relation of such a rate to the normal cost must of necessity be arbitrary for it is not in itself a cost at all but merely the *ratio of wasted capacity to utilized capacity.*"

This is a somewhat fine distinction. For all practical purposes wasted capacity is a cost. Capacity is a production factor of evanescent nature which, not used at the time, is lost forever. Its cost has, however, been incurred and has, or must be paid for. The mere fact that a capacity has not been utilized to the full does not lessen the fact that it is a cost. If material is purchased and spoiled in the course of the operations necessary to convert it into the finished product, the waste material is charged up as a cost. Likewise, if capacity is not utilized and is lost even more irremediably than is spoiled material, it is also a cost.

Though this is true, the cost is of a peculiar nature and is well shown separately in the cost records. As stated by the same author,* "In all percentage systems this wasted capacity is mixed up and charged along with utilized capacity as an increased total incidence of expenditure. No doubt one of the reasons why the practical mind has looked coldly on all burden-distributing systems is an unconscious perception that

* "Production Factors," p. 122.

they cease to mean anything definite as soon as there is any departure from full time and normal work."

In other words, when wasted capacity is brought into costs, these costs are not stable but vary possibly from day to day, according as the work runs. If, however, this is the condition there is no reason why it should not be reflected in costs. On the contrary, it should be reflected in costs and all that can be reasonably required is that it be reflected in such a way as to show clearly the disturbing element—i. e., efficiency failure.

§ 259. The Function of the Supplementary Rate.

The supplementary rate, where employed, is first utilized to distribute such items of expense as are not directly charged through the machine. It is then utilized to distribute wasted capacity. A very clear resumé of both the machine-hour plan and of the function of the supplementary rate is given by Mr. Church in the following quotations:*

"The full outline of the new plan may now be seen. First we consider each machine as an independent production centre, allocating to such centres all the expenses and charges which can, on reasonable analysis, be considered chargeable as a composite rent or machine rate for all the factors of production therein concerned. Second, we charge to a monthly shop-charges account, all charges whatever incurred by that shop, including all the items specifically represented in fractional detail by the machine rates, and also including, of course, such general items as cannot be represented in the machine rates, of which the most obvious item is the supervision of a head, or foreman.

"Then, as each machine is occupied on jobs the latter are debited with so much per hour as machine rate, and at the end of the month the total amount so earned by the machines, *is deducted from the total shop expenses,* leaving a balance

* "Proper Distribution of Expense Burden," pp. 56, 57.

which is distributed over the same jobs as a *supplementary rate.* The ratio of the supplementary rate to the amount distributed by the machine rates forms a varying barometer, whose fluctuation is an index to the current efficiency of the shop.

"It will, of course, be obvious, from what has already been said, that when the machines are all running full time the supplementary rate will consist of the general charges alone, such as the foreman's wages, which have not any individual connection with particular machines. This will be the condition of maximum efficiency in the shop. In proportion as all machines are not kept full of work all the time, this ratio of the supplementary rate to the amount distributed by the machine rate will begin to rise."

As will be noted under Mr. Church's plan, the only charges against machines for failure in efficiency is when they are not kept fully employed. Failure to attain the full output even though running at full time is not shown as an independent charge, but may only be discovered by the lessened ratio of production or the higher machine rate on each unit of production, When, however, they are charged with a fair maximum efficiency production any failure to attain the proper output is at once reflected in results.

As stated by Mr. Church, the lost time of the supplementary rate "merely represents the accidental circumstances of the shop during the period, and to that extent is a barometer of conditions.

"It may be asked, why go to the trouble of distributing it? There is in fact no particular advantage in doing so from the costs standpoint. As it only represents *the elimination from normal costs of something that would otherwise conceal them,* any significance that the ratio possesses can be just as well expressed by a single monthly total made known to the responsible parties. Its distribution is in fact a concession to those who like to see every item of expense 'distributed' over

work, without regard to whether such distribution teaches anything or not. * * *

"It will be obvious that when the costs of all work done in the month are taken, the total expense will have been charged to it in two portions, viz.:

Total Shop Expense in a Given Period

Utilized expense, transferred to work at tool point.
Wasted expense, transferred to work per Supplementary Rate on an hour-value basis, as a separate element of cost.

"It must not be overlooked that the ratio of wasted to utilized capacity is, in itself, a most important and significant figure, * * *. It is a figure of the utmost interest to the management, but whether anything is gained, *from the costs point of view,* by expressing it as a portion of individual costs is, as stated above, a matter open to argument."*

The theory of the supplementary rate is well rounded out by Mr. Church's exposition, but under ordinary conditions the author doubts the wisdom of the refinement of detail involved. Unless the conditions are peculiarly advantageous, it is liable to cause congestion in the accounting department and perhaps tend to becloud the sought-for results.

Mr. Church shows labor in his tabulation as a distinct item separate and apart from the cost of the machine service, this latter alone being expressed as an "hourly rate at the tool point." The author does not take issue with Mr. Church but prefers to include the labor costs and all other component costs including the supplementary rate, in the "hourly rate at the tool point." By so doing clerical operations are minimized and, when desired, the hourly cost can be quickly and easily segregated into its elements by reference to the record of the individual machine (Figure 189)—a barometer which tells plainly the story of its performance.

In the case of textile and similar industries where groups of machines are treated as industrial centers, and labor is

* "Production Factors," pp. 123, 124.

paid for at piece-work rate, it has been the author's practice to keep a sharp record of idle hours by "cause" numbers, but not to go to the extent of actually charging the lost capacity of such hours to a ledger account or other record of positive financial entry. The magnitude of the totals of idle machine time from avertible causes in a single month, is at times startling. Indeed, one of the chief functions of the machine-hour plan is to enable the management to anticipate and prevent such losses.

§ 260. The Fixed Machine Rate.

It may be well to differentiate the principles involved in the machine-hour method from those of the so-called "fixed machine rate." In this latter method "all the charges relating directly to the machine or process are entered in the cost, precisely in the same manner as in the other system. But the indirect expenses in the new machine rate are distributed over the machines or processes, and included in the machine or process cost, in calculating the rate per hour; whereas, in the fixed machine rate, the indirect expenses which cannot be identified with particular machines or processes are pro-rated over the entire production on a percentage or some other basis.

"The fixed rate method differs from the other also, in that the rate, to begin with, is based on an estimate or, at best, on what happened during some previous period. It also assumes an efficiency of 100 per cent. in running, which is a condition that has never been known to exist. Crediting the departmental indirect expense account with charges based on running maximum time, where the product is only charged with the actual running expenses of the machines when they are at work, necessarily produces a credit balance for the indirect expense account in a comparatively short time. That is, the indirect expenses of the department appear in the charges to the production as being much greater than they really are. Compensation for these extra charges must be

made somewhere, or the costs obtained would be nothing short of ridiculous. Therefore, the difference or the amount by which the indirect expense account exceeds the actual charges, is deducted from the general indirect expenses before they are distributed.

"The nature of this proposition can be understood more clearly when it is considered that if there are a great number of machines idle, the general indirect expenses appear to be much diminished. In fact, if a major part of the equipment were not at work they would disappear entirely. At the very best, this results in a distribution that is so inexact as to be valueless to the manufacturer. Nor is it correct in amount, when considered in its entirety. The plan of deducting the rate of idle machines from the general indirect expenses assumes that there are no direct expenses whatever connected with the machine while it is standing idle. But we have seen that this is not true. Interest, floor space, rent and depreciation, to a more or less extent, besides other expenses of this nature, go on just the same, and no provision is made for their incorporation in the true costs of the plant. * * *

"The differences, and resulting errors, are accentuated because the rate is based on full running time, instead of the average or actual running time, which, after all, is the logical basis for a machine rate. It is not a question of what a machine can do but what it does do, day in and day out, even if this represents only 40 per cent. efficiency."*

In the machine-hour method as set forth herein, it will be seen that what are called annual charges (see § 240) are separate and distinct from term charges (see §§ 241, 242) and that while inactive machines still participate in the annual charges, they do not participate in the term charges save only so far as benefit is received.

* Nicholson, "Factory Organization and Costs," p. 54.

CHAPTER XXVI.

THE MACHINE-HOUR PLAN (Continued).

OPERATING DETAILS.

§ 261. Method of Application.

When the installation and maintenance costs of machines have been scientifically determined and the rate per hour for each individual machine has been worked out, the application of machine costs becomes not unlike that of labor costs and is best effected by means of time or job reports (see Ch. VIII). Any suitable plan of report may be adopted, but in order to get maximum results with a minimum of effort the regular job cards or time reports should serve as a basis for the machine costs charged to a particular job. The cards then govern both the labor time—when charged separately—and the machine costs.

§ 262. Time Reports.

Where the product is of a nature requiring a number of varying operations, every machine work job should have a job card issued for it; a supply of such cards with space for the workman's number, the machine number, the department number, and the closing date of the current pay period, being kept in stock by a department clerk and issued by him as new work is given out. One such card is given to each operator in charge of a machine and such operator is required to ring "on" and "off" morning, noon, night, and overtime for all work done on the particular job during the current pay period. The starting time is rung when the job is first started, and finishing time when the job is completed or is suspended.

In cases where the product is common to a number of machines which are grouped into industrial centers or divisions for cost-finding purposes, as for instance, looms, spinning frames, and knitting machines, and particularly where there is but little variation in style or quality of product of the individual machine, a time recording clock may be used. Or when the work done is on a piece-work basis, the old style brass check plan may be used for in and out time, if preferred, and a form of time and product report, such as shown in Figure 124, be utilized. This form is properly stamped and filled with machine numbers, date, etc., in the cost office once each week preparatory to its use by the operator in the succeeding week. The registration of starting and stopping time on the coupons of this form is best accomplished by a time recording device in the department. Any variation of quantities produced comes through the inspection reports.

§ 263. Grouped Items.

When the product is standard, and a piece-work, premium or bonus plan is used, production orders put in work can be divided into suborders of a fixed amount, as for instance, of 10, 25, or 100 units, depending entirely upon the nature of the product. (See §§ 67, 227.) By dividing orders of this kind into suborders, the work is handled with greater comparative ease, it may be distributed among more machines so as to employ the highest percentage of capacity, cost finding is easy, and friction in, or congestion of the work in process is avoided.

When this plan is employed a form similar to Figure 23 may be used to advantage. This is a tag in the nature of a job follower, which is properly filled out in the order department and issued, one tag with each suborder or "item" as these suborders are sometimes called. When an operation is started, the time is recorded on the proper stub or coupon of this tag, and when the operation is completed on all the

pieces included in the "item," then the finishing time is recorded. The operator retains his stub or coupon as evidence of the work he has done, and the goods together with the remainder of the tag are passed on to the inspector, who may in some cases be merely the operator on the next operation. This inspector or operator becomes responsible if he signs for something not perfect. At the end of the day or perhaps of the week, the operator or a clerk lists the coupons on a sheet prepared for the purpose and turns them over to the foreman or some other designated person, taking a receipt therefor.

This plan has a great many strong points about it and but few weaknesses. The pay record of the employees is easily kept without confusion or errors, and the coupons can later be reassembled with the master stub, or be utilized under any desired segregation of recording processes.

§ 264. Application of Efficiency Bonuses.

Efficiency bonuses of any nature whatsoever should not be treated as a supplemental cost but should be included with the cost of labor as shown in column 2 of the term cost record (Figure 191). There are three reasons for this:

(1) The volume of clerical work runs into almost prohibitive proportions if efficiency bonuses are kept separate.

(2) When by any course of reasoning or calculation the difference between bonuses and labor costs has been carefully worked out and comparisons drawn, the results are in the main abstruse and of so little cost-finding value that "the game is not worth the candle."

(3) Even where results of value are apparently secured by a separate application of efficiency bonuses, it will be found on investigation that the same results could be brought out automatically through the action of the individual machine rate. Nothing should be introduced into cost finding that can be omitted without the loss of necessary or desirable results.

§ 265. Efficiency Suggestions.

If any high degree of efficiency is to be obtained under the machine-hour plan—or any other system of costing—it must be brought about by carefully laid plans for the work to be performed. If individual job cards are used, the foreman or clerk must prepare the cards before they are actually necessary, so that workmen need lose no time in waiting for orders or time cards. Where cards bear the stamp number of the operator or the machine, together with other designating and safeguarding data, a requisition similar to that shown in Figure 112 should be used as a prerequisite to the issue of cards.

The time cards called for by the requisition should cover the probable quantity of each kind needed for the succeeding pay period for each employee or machine. Usually time cards of this character are prepared by inserting the machine number by means of an adjustable numbering stamp, and also by stamping or printing in the date of the next pay period, together with the department number or letter; and in cases where piece-work coupons are attached, some identifying mark difficult of imitation is usually stamped or printed on each coupon. Frequently, what are known as addressing machines are used to insert the name of the operator and other data.

The time cards when prepared are sent to the various departments prior to the beginning of the pay period in which they are to be used. If more cards are needed to fill out the period, they are furnished on requisition as before, and if at the end of the period a few remain unused they are returned to the cost office, properly checked up, and then destroyed or perhaps merely redated.

Where card clocks are employed and the registration of daily "in" and "out" time is required on the individual job cards, the proper clerk will at the beginning of each pay period have new cards in place in the card rack fifteen minutes or more before the official starting time for the department.

New cards for each pay period present a number of advantages. An argument sometimes urged against the practice is the embarrassment caused when production orders are started in work just prior to the beginning of a new pay period. This is, however, a matter of minor importance, the old card being rung "off" at the close of its period and a new card issued and rung "on" for the same job at the beginning of the next period.

Job cards should be made out ahead for all employees who register on a given job number. These cards can be kept filed in a "jobs ahead" rack, so that the workmen need lose no time between jobs. Where rush jobs come in for which cards have not been prepared, the workmen need not wait for the new card if same is not immediately at hand, but ring "off" on the finished or suspended card and proceed with the new work, and the foreman or his clerk can write in the starting time on the new card with his pen, affixing his initials thereto. No one else should have this privilege save specified officials.

When a man rings "off" on a job card, he should deposit it in a box kept for that purpose. If the job be finished he will put the card in the "finished jobs" portion of this box, but if otherwise in the "unfinished jobs" portion. Job cards before being deposited in the box should be so filled out or marked as to show the condition of the work. For this purpose there should be provided on the reverse of the job card (see Figure 97) a series of fractions together with the word "Finished." If the work is estimated to be three-fourths finished the workman puts a ring around the fraction "¾" with his pencil. If he thinks it is about one-fourth done, his pencil ring is placed around the fraction "¼," etc., etc. These are merely estimates but if made with good judgment should be fairly accurate.

Where time clock registration is used, some plants do not require the employee to ring "out" unless he finishes the

job or leaves before or after regular quitting time. This practice, however, the author does not approve as it leaves an unnecessary loop-hole for dishonest practices. Nor is it to be commended for its saving of time, for, if properly trained, employees will pass by a clock of modern type, and register their "out" time at the rate of forty-five per minute. If there is any inclination toward rushing and confusion, a person in authority should watch the line occasionally and displace and send to the rear of the line any one seeming to have undue anxiety to get in or out ahead of his fellows.

The time clock is a most desirable "efficiency" adjunct. It is difficult to "beat" a time clock. Sometimes it is done, but as a rule even men who are not honest on principle find it best to be honest as a matter of policy when a time clock is involved.

§ 266. Non-Chargeable Time.

A report should be made of every shut-down or delay, no matter what the general plan of machine-time cost finding employed. This is essential if efficiency is to be raised to its highest possible point.

In cases where prompt records are kept for idle time, the operator can report "off" on the machine time card and "on" on the idle time card when the delay is likely to be ten minutes or more. Shorter periods should be reported on the same idle time card but the entry may be made with pencil. When an entire department is required to shut down, the foreman can report for the department on a single idle time card rather than to require each employee to register on the clock. The most frequent causes for idle time are as follows:

(1) Waiting for stock, or mistakes as to stock.
(2) Waiting for tools or other appurtenances dependent upon others for delivery.
(3) Waiting for specific orders or instructions, a condition usually resulting from insufficient original information or inability to get at foreman, etc.

(4) Absence of operator or assistant.
(5) Lights out.
(6) Improper temperature.
(7) Spoiled work in this or other departments. (The delay occasioned by the discovery of spoiled work comes properly under this head but *not* the time consumed on the rejected product.)
(8) Power off. (Where practicable, this idle time should be used for machine cleaning.).
(9) Supplies or equipment exhausted.
(10) Cleaning machine.
(11) Repairs or local mechanical difficulties occasioning poor action.

§ 267. Cutting Down Lost Time.

Statistical records should be kept of all shut-downs and delays. To reduce these to the minimum, the various departments are sometimes pitted against each other by means of peak-sheets and percentages, so that foreman and employees may strive to have as good a record as possible. Prizes, to be awarded to the department or departments with the highest attainment, may be profitably employed. Such prizes are usually offered for:

(1) Lowest record for idle time resulting from causes within departmental control.
(2) Greatest gain in active time over preceding period.

Where any such plan is inaugurated it must be carefully worked out at the start and a formal set of simple but positive rules established, more particularly to determine what shall and what shall not be considered. Also it should be understood that any benefits gained by the men through their efforts are to be enjoyed by them and not to be monopolized by the foreman. The competition should take into consideration spoiled work, particularly when the work was spoiled within the department where it was discovered.

§ 268. Spoiled Work.

Spoiled work should always be strictly accounted for. A form for the purpose is advantageous. Figure 149 shows such a form with a detachable portion, one part of the form providing a financial record for the cost department and the other part having blanks for a statement of the work spoiled and an explanation of the reason for such spoilage.

Spoiled work rarely results from defects in the machine or its operation, and the machine time is therefore properly applied to spoiled material. Such time cannot by any reasonable construction be spread as inactive time, since the machine as a rule will have properly performed its functions. Losses of this class, therefore, involve not only the loss of the spoiled material, but the loss of the expense and the labor expended upon this material.

§ 269. Handling Time Reports.

When the machine operator reports on forms similar to one of those shown in Figures 98, 102, 106, 107, 113, 118, 122, 123, or 128—modified for machine-time cost finding—the reports are first used in compiling the pay-roll time of the employees. After this is done, as a report of this form cannot itself be filed under the order number or numbers to which it relates, each item of debit to an individual order number is posted to a cost compiling sheet or record of some kind.

The only mechanical aid available for calculations with forms of this type is the patented device known as an automatic wage calculator. With this machine, the starting and finishing times are duly "set," a lever is pulled, and the elapsed time with its equivalent in money value is automatically printed. As the device will separately record and add the items of both time and money values, it is a safeguard against error arising from lost or misplaced cards. A subsidiary form of card can be used for these calculated results, and with machine numbers and order numbers properly affixed, the

subsidiary cards may then be filed under the order numbers concerned and the posting from the original card be eliminated.

Forms of time reports similar to those shown in Figures 101, 117, and 124 are frequently employed. The wage calculator can be used with these, as also may certain types of time recording devices. When any of these forms are used, the pay-roll time of the employees is first compiled, after which the coupons of the time reports are detached and filed under the particular order numbers to which they apply.

In cases where the machine operator makes his record on individual job time reports, the pay-roll time of the employee will first be compiled, after which his cards or reports can be filed under the particular order numbers to which they apply.

§ 270. Separable Machine Time Reports.

A convenient method of handling separable machine time reports—i. e., individual job time reports or reports with coupons for individual job reports—is to file them in a container under their specific order numbers, job numbers, pattern numbers, etc., as the case may be. The job follower (Figure 21) and the cost card envelope (Figure 156) are good examples of such containers.

Another good method of handling individual job time cards is to provide filing drawers in which for each machine number appears a guide card bearing the corresponding number. As the reports or cards are collected each day for finished jobs, they can be distributed to the proper drawers in front of the guide cards bearing the machine numbers to which they refer. At the end of each pay period, or as much earlier as is advantageously possible, the cards are calculated both as to labor cost and machine time value, and the pay-roll figures are compiled therefrom, preferably by listing on an adding machine, the totals being shown in pay-roll form as in Figure 131 or 132.

After the pay-roll data has been utilized, the reports or cards are refiled by order, job, pattern, style, or other designating number as the particular plan of cost application may require.

Guide cards are necessary for this purpose. Where the pattern or style number is used and is a fixed symbol, then such number may be permanently printed on the guide card. Where, however, progressive job or order numbers are used, then divisional guides are most conveniently prepared to represent the hundreds and thousands, with permanent ciphers for units and tens. Thus a general guide card of this nature might be numbered 24100. Cards are then numbered from 1 up to 99 as subdivisional guides. If a time report belongs to job 24,127, the general division guide 24100 is looked up and the subdivision 27 is found and the report filed under this guide number. As orders in process are completed the reports filed under each order number are utilized as may be necessary and are then permanently filed. The subdivisional cards are then ready for use under some other general division.

It sometimes happens when this system is employed that a few much delayed or long time jobs are still active when all the other jobs under that subdivision have been completed. In such case a few cards numbered in pencil may be used for these "hold over" jobs and the subdivisional guide cards be released for use under a new general subdivision.

The summarization of the data filed under the order or job numbers may be left until the end of the cost period. It might even go over until the operations on that particular order or job number are entirely completed, but such procedure is not ordinarily advisable since the greatest benefit of any efficient cost finding plan is not obtained unless there is a cleaning up of all cost records every monthly or four-week period. It is easily seen that if this is not done there never would come a time, save by the merest chance, when a given machine record (Figure 189) would show *all* of the

credits that were due it, as some of the cards representing certain hours of its use would almost certainly be lying unrecorded in the job or order number file.

Where the numeric file plan is followed the material cards or requisitions can be handled in the same manner as the time reports.

CHAPTER XXVII

THE MACHINE-HOUR PLAN (Continued).

PRODUCTION RECORDS.

§ 271. Production Classification.

When the elements of cost against an order number have been compiled, the totals of each should be recorded on the Production Register shown in Figures 24, 25, 26. In connection with this form the master sheet (Figure 24) is used where secrecy is desirable. Four classifications of shop order numbers are provided for on this form, as follows:

(1) *Machine.* This refers to specific orders for given quantities of finished machines—or in other cases than machine building, units of product. All company work partaking of the nature of a capital expenditure is included under this head.

(2) *Stock.* This designates any portion or parts of product made in anticipation of future needs.

(3) *Repairs.* This covers all work done on spare or repair parts to be sent out at once on commercial orders.

(4) *Expense.* This covers all work produced for the use of the concern and not chargeable to capital expenditures.

In practice a designating serial number is given to every order under each of these classifications, though the orders under each classification do not usually appear on the Production Register in uninterrupted sequence. Thus the order numbers on a given page of the Production Register may be as follows:

Line No.	Machine	Stock	Repairs	Expense
1				3,092
2	19,704			
3	19,705			
4		27,914		
5		27,915		
6	19,706			
7			12,309	
8				3,093
9	19,707			
10			12,310	
11		27,916		
12			12,311	
13		27,917		
14	19,708			
15				3,094

As will be seen, an unbroken succession of orders as a whole is maintained on the Register, but not as to each class of product. In each class of product, however, the successive order numbers bear a serial designating number.

Each successive master sheet—where these are used—bears a progressive number and the month in which the first entry is made upon it. So long as it is in active use, or any of the order numbers listed upon it are unfinished, the master sheet is deemed alive or active. When there are but few remaining order numbers upon a sheet, it is expedient to carry these forward to a new master sheet, indicating the new sheet number on the old sheet under the column headed "Forwarded to Sheet No."

§ 272. Production Charges.

Each line number on the master sheet represents an order number, and the corresponding line number on the corresponding slip sheet (Figure 25), i. e., the active slip sheet which bears the same progressive master sheet number, will give the line on which entries are to be made for that given order number. The slip sheets have columns for charges as follows:

(1) *Material—Parts.* This covers the raw material in semi-finished product, with labor and expense

added, and includes those parts known as semi-finished product, made for stock usually in advance of immediate necessities and withdrawn on requisitions or other withdrawal reports.

(2) *Material—Raw.* This includes any material produced for the particular job or drawn from stock on requisitions or other withdrawal reports.

(3) *Machine—Hours and Cost.* This refers to the machine time reports already fully explained.

(4) *Labor—Hours and Cost.*

(5) *Expense—Direct.* This includes all items of expense incurred for specific order numbers and therefore not to be diffused over all orders. This column can be used with the machine-hour method.

(6) *Expense—Diffused.* This includes all overhead costs, loaded preferably on the man-hour plan.

The adding machine can be used to advantage in handling the data for the first three of the foregoing items. The totals of the summaries are entered in the proper line and column after they are ascertained from the master sheet by a confidential cost clerk.

When the machine-hour plan is used it is not always practicable to have *all* departments of the plant on the same basis, as for instance the assembling department which has no machinery excepting perhaps compressed air devices, and must therefore be put on a cost basis of labor and expense.

If a master sheet is kept for each separate department, then in those departments not on the machine-time plan only one entry will be made for the month under the column headed "Constant"—that entry being the expense constant for that particular month. If, however, one master sheet be made to serve for the entire plant, then the expense constant will show opposite each item for each department in which labor charges may occur. Where this must be done, more than one line number may be allowed on the master sheet for each order if necessary.

§ 273. The Expense Constant.

Once determined, the expense constant will not need adjustment more than perhaps four or five times a year, unless vitally affected meanwhile by changes of condition. The cost analyses record will sharply indicate any cost variations as they occur, and usually the reasons can be ascertained and the variations be remedied so that the constant need not be seriously disturbed. Theoretically it is correct to calculate the expense constant monthly, but in practice such frequent changes unnecessarily disturb comparative figures and also make impossible the compilation of costs during the interim between closing periods.

This need not be construed as a departure from accuracy, but quite the reverse, as overhead costs based on any one given month do not present reliable figures. However, it must be emphasized that any causes of variation that do occur must be quickly ascertained and removed as far as possible, or, if permanent, the expense constant must be changed to conform to the changed conditions.

In practice it will be found that the variations of expense constants from period to period are but rarely traceable to the production department, but come most largely from the fluctuations in the demands of the sales department. If the selling department could maintain an even flow of orders, then the works manager could run the plant in a more even manner than is otherwise the case. The foreman has but little voice in the volume of his product, but as orders press or slacken he is either admonished to crowd out the work, or to ease up a little and lay off some of his men. For this reason he cannot altogether control the fluctuations of his overhead burden. He is, however, expected to keep it down within reason and the lower he gets it the better foreman he is, provided his product is right.

A good exemplification of the fact that low production means a high burden, was had in many plants following the

panic of 1907. At this time the plants were kept running but the orders were few and costs in consequence were high. As a matter of fact, the actual production costs were really no more at that time than at any other, save only for the increased expense constant. In many cases the excess amount of this increased expense constant was treated altogether as an extraordinary cost and absorbed through the Profit and Loss Account instead of being loaded on to the cost of production.

§ 274. Production Summary.

The Production Register (Figures 24, 25, 26) has more particularly to do with that class of product which requires varying operations on a given machine and varying lengths of time for these operations. In the case of textile products these conditions do not obtain, the operations being more or less common to all the machines in a given group or section, and the cost unit being based on the product of such group or section rather than on the product of any single machine. For such products a form similar in character to the "Production Summary" shown in Figure 178 answers the purpose better than the Production Register shown in Figures 24, 25 and 26.

In the form shown in Figure 178 the operations are divided into two classifications:

(1) *Preparation.* This shows the time consumed in the various necessary preparatory operations which may be common to all fabrics, or which can be spread over but one or more specific fabrics on a yardage basis. The time required for such preparatory operations can be standardized to some extent.

(2) *Production.* This shows the yardage of various qualities produced each week and the machine time consumed in their production.

By means of a four-weekly totalling line, the total can be ascertained for each quality for each loom, and these totals

can in turn be summed up and the progressive total be carried forward to and include the last loom in the particular division.

§ 275. Summary of Sold Machine Hours.

Another class of product is that which varies as to details on different jobs and requires varying lengths of time for the preparatory processes. These latter cannot, therefore, be standardized. The "Summary of Chargeable Machine Hours," Figure 179, is adapted for a product of this kind, applying more particularly to the type of machine of which printing and lithographing presses, whether rotary or reciprocating, are characteristic. The form can also be used with box-nailing machines, automatic screw machines, and in fact any type of machine, either automatic or hand-fed, which when once prepared, performs its functions at a fairly even rate of speed, and the product can be measured by units per hour covering several machines of a given class, even though each may be producing a somewhat different kind of product. The selling price of the product of this type of machine is usually based on the number of units produced per hour.

The summary of chargeable machine hours is also used in the Sold-Hour Plan of cost finding and might be used advantageously in connection with the Production Register of Figures 24, 25, 26, as the summary is somewhat of a detailed production sheet while the Production Register is a controlling or synthetical record which with slight modifications may be used with any cost-finding plan.

§ 276. Production Credits.

By reference to the form of Production Register shown in Figures 25, 26, a group of columns will be seen on the left-hand side of the page (Figure 25) headed "Charges." To the right of this group (Figures 25, 26) appears another group headed "Credits." The subheads of the two groups

are identical. In the charge columns, the constituent elements of cost are entered in the analytical state so far as totals are concerned. When a given order is completed, the slip sheets for the months or periods during which charges were passed through such order, are scrutinized, totals are drawn of the items corresponding to the subheads of the credit group of columns, and these totals are entered in their proper columns in the slip sheet of the current month on the line number of the particular order.

As every debit must have a corresponding total of credit, the total of the various constituent elements so ascertained will on the same line as the credits, be entered in the distribution columns of the Production Register under one or more of the following heads as may be necessary: "Finished Parts," "Finished Product," "Other Departments," "Other Accounts."

If any items are to be transferred to other order numbers, a record of this transfer is made on the form shown in Figure 157. Such transfers usually occur where two or more units of product are required at the same time on different order numbers, but can be worked to better advantage if produced together. They are usually carried to completion under one order number and are then transferred to the order number or numbers to which they belong.

When all the columns of the slip sheets are footed and a progressive total has been made of each, these totals are entered upon or posted to controlling or synthetical accounts which bear respective titles corresponding to those of the production credit columns. These accounts will, when properly posted and compared with the two sides of the process accounts, present a debit balance, in each case representing the value of the total of items of each particular element still remaining in work.

Similar data, in a summarized form, is to be found at the right-hand side of Figure 26 under the heading "Controlling Record." The entries for the column "Totals This Month"

are found, as already described, by adding respectively all the debits and all the credits to the individual order numbers on the slip sheets for the month or period and then posting these totals to the respective debit and credit subcolumns of "Totals this Month."

The entries for the subheading "Totals to Date" are found by adding the "Totals this Month" to last month's "Totals to Date." The difference between the debit and credit side of "Totals to Date" will be the value of goods in process, the accuracy of which may be proved by having each separate line of the Production Register summarized and the totals placed in the proper columns. The footings of these columns must prove with the footings of the "Totals to Date" column, since the sum of the parts must equal the whole.

§ 277. Comparative Statistics.

When the Production Register requirements have been satisfied, the machine cards or reports are analyzed and thereby fulfill one of their most important functions—i. e., that of comparison of and the subsequent affixing of values to the services of individual employees.

Every plant of varying nature has its own peculiar operations. A record should be kept of these operations for efficiency purposes, care being taken, however, that the clerical work involved does not become burdensome. Such records may easily be made so complicated and troublesome that they are not worth while.

For convenience each varying operation of a plant should have a designating number or symbol, and such numbers or symbols be used instead of written descriptions. Thus the general operations in a metal-working shop—where numbers are employed—might list out in the following general form:

(1) Annealing.
(2) Assembling.
(3) Babbitting.
(4) Bending.

(5) Blowing.
(6) Boring.
etc., etc.

Also there are frequently operations peculiar to individual departments which are to be listed under a proper series number. Forms designed for keeping a record of operations are shown in Figures 163, 165-8, 170, 182, 183.

In the case of machine construction, agricultural implements, chairs, or in fact any product which is assembled from constituent parts previously made in the same plant or purchased elsewhere, a collating record such as that shown in Figures 182, 183, may be used. Where this form is employed, each part or element of each machine built has a card record upon which are shown the dimensions, grades, weights, and other special designations of each constituent part or integrant, where these are of sufficient size or importance to justify a separate record. Upon the card record appears also the number of units of each part required for the completed machine or part.

As material for these parts is drawn on requisition, the requisitions can be checked on the analysis cards (Figure 182), and overissues, if they exist, be thereby discovered. Each card has space for twelve or fifteen orders to be recorded, and as goods of this class are usually made up in quantity for stock the ordinary life of the card in current use will perhaps be two years. It is always good for reference purposes. Under some conditions the information of the analysis cards can be used when issuing bills of material, instead of resorting to stores orders or requisitions.

The reverse side of the analysis card (Figure 183) consists of spaces similar to those on the lower part of the face of the card (Figure 182) and is designed for an analysis of labor and machine time costs by operations. Each operation required in the making and assembling of the particular machine part is represented on the card by its operation number,

symbol, or designation, and under each operation heading on the card is listed the several reports as they are received. It is from these that statistical information as needed is gleaned.

It is not necessary to keep the time of operations, which are part of the regular routine, every time such operations are performed. It is also to be noted that in many cases where the same machine or the same workman performs several successive operations, such operations can be grouped, thus cutting down the number of cost cards where their separate records are of no great value. In passing it may be said that there is little to be gained by dividing cost cards by operations where the speed and ability of the individual workman is positively known from past records, and the total time his cards show on current work does not exceed the totals on his past records.

GENERAL CLASSIFICATION OF COST-FINDING PLANS.

1. Elemental costs recorded in the general books and only totals considered at the end of a given period, no interim charges of a positive nature being made to specific orders or processes. — Estimate and Test Plan.

2. Material, labor, and expense costs positively applied to individual orders in process, in the exact proportion of their several contributions to the finished unit. — Specific Plan. Machine-Hour Plan. Sold-Hour Plan. *Belongs in part to both classes.*

3. Labor and expense costs positively applied to a given process and the inclusive total cost of such process, per unit of measurement, applied to orders in process on a unit basis, regardless of intrinsic value of material affected or the length of time consumed. — List-Percentage or Process Plan.

PART VI.—COST-FINDING CHARTS.

CHAPTER XXVIII.

CHARTING A COST-FINDING SYSTEM.

§ 278. Function of Cost-Finding Charts.

The complete scope and the detailed operation of a system of records is not easily grasped when it is viewed as a whole. For a just conception of its effect and operations, its component parts must be clearly seen and the relationship of one part to another and to the system in its entirety be positively determined.

In cost finding the importance of this clear, mental grasp of the system in use, or to be used, is particularly important. Such a system is frequently complicated and always embodies many features of detail. If these are all properly adjusted; if there are neither gaps nor overlaps; if the possibilities of "short-circuiting" are eliminated; if the forms and records are properly adapted to the demands to be made upon them, the system will be a harmonious whole, intermeshing easily with the general records, and smooth and effective in its operations. Such a system is best devised, or, when devised, is most easily grasped, by the construction and use of a diagrammatic chart.

The "cut and try" plan of machine construction does not obtain in modern machine practice. No more should the "cut and try" plan be employed in the installation of a cost-accounting system. In machine work every element is accurately planned and the respective relations and operations

of each determined in advance. In like manner, in devising a cost-accounting system, the exact ends to be attained, the methods by which they are to be attained, the forms and records to be employed, and the relationship that exists or should exist between these various forms and records, should all be fully determined in advance of the installation. It is here that the chart will be found most useful.

It is not always a simple matter to "chart" an accounting system for a specific factory, particularly where intricate conditions obtain. Nor is it a simple matter to present a comprehensive chart of a general plan of cost finding not devised for some certain factory. The charts shown in the following chapters will, however, give a fair presentation of their respective systems of cost finding—a presentation which should be of assistance to the accountant in tracing out the operations of these cost accounting systems, in constructing charts for projected systems, or in charting a system already in use.

§ 279. Arrangement of Charts.

The charts shown in the following chapters (Figures 5 to 9) present in diagrammatic form the books and records used in the systems of cost finding they respectively represent. These are so arranged and connected as to show the functions of each, the course of entries from one to another, and the general relation each bears to the others and to the system as a whole.

In the charts as presented, the lettered arrows indicate the course of entries from one record to another, while the various records and forms are represented by "boxes" or rectangular outlines. Any other distinctive form would have done as well; the squares having been selected as a mere matter of personal preference and because they conveniently fit the available space. The location of the various forms on the chart will be controlled to some extent by the necessary course of the arrows which indicate entries.

The shaded central portion of the charts (K) represents the synthetical or controlling records or accounts. If the arrows indicating the course of entries pass through this shaded portion, it indicates that corresponding entries are made in a controlling account. Thus in Chart 6, the arrow "c" indicates a certain relationship between the Purchase Analysis (A) and the Cost Collating Records (I). The arrow crosses the shaded portion (K). If certain material is purchased for a specific order in process in a given department, the entry covering the purchase will appear on the Purchase Analysis under the "Material" column in the "Goods in Process" group. In the regular routine the item will be posted—as shown by the arrow "c"—from the Purchase Analysis to the Cost Collating Records in the column headed "Material—Raw," appearing there on a line opposite the specific order number concerned, which is thus properly charged with the item. In due time the totals of the Purchase Analysis are transferred to the General Exhibit, the total of the "Material" column being shown under the corresponding column of the General Exhibit; i. e., "Material, Dr." in "Goods in Process" group.

Thus the entry will be "under control" for the reason that the totals of all balances of the particular month in all the various debit and credit columns of the Cost Collating Records must exactly articulate with the corresponding column in the General Exhibit, and if any item of material purchased during the month has been lost in the posting from the Purchase Analysis to the Cost Collating Records, the omission will be at once discovered on comparing the totals of the corresponding columns of the General Exhibit and the Cost Collating Records. In like manner, all other entries indicated by arrows crossing "K" will be subjected to control, the exact method depending on the design of the general plan of cost accounting employed.

If an arrow does not cross the synthetical area—as for instance arrow "j" in Chart 5—it indicates that such

entry or relationship is not subject to control or to proof by balance.

§ 280. Functions of Forms in Cost-Accounting Systems.

The forms referred to in the following chapters have each in themselves points of value, but in order to be of the greatest value in any system of cost finding, they must intermesh or harmonize with the other records in such manner as to form a complete and smoothly working system.

It must always be borne in mind that forms in themselves, no matter how well adapted to their special purposes, do not constitute a cost system but are merely operating integrants. They are merely a means of recording, exhibiting, and preserving the operations of the system.

Forms may and should vary greatly in applying the same system under differing conditions. Their selection and arrangement is an expression of the designer's conception of the requirements of the system, both as to its records and to relationship existing between these records, and the forms selected and their arrangement will be good or bad according to the ability of the designer. They should always be made to conform to the requirements of the case in hand. Stock forms of any kind can at best apply to but a limited number of cases.

§ 281. Constructing a Chart.

The construction of a chart showing with reasonable accuracy and clearness the operation of a specific cost accounting system, implies something more than a mere knowledge of cost accounting. It requires not only this, but a more or less thorough knowledge of the conditions obtaining in the particular factory.

While this is true, it is a mistaken idea—prevailing in some quarters—that the designer of a cost system for a particular line of business must have served an apprenticeship in some technical capacity in that line. It is not the province

of the cost accountant to instruct those in charge of an industry in its physical technicalities of manufacture. If the accountant is well versed in the practice and technicalities of his own profession, it makes no vital difference as to the exact nature of the operations to which his attention is turned. His function is to provide the most convenient and effective methods of recording the results of these operations; and a familiarity with the operations themselves, while desirable, is not essential.

Different conditions exist in every different plant and must be studied before a system of accounting can be devised for that plant. If the accountant is already familiar with these, so much the better. It eliminates the exhaustive survey of the plant and the conditions that actually exist which would otherwise be necessary. If he is not familiar with the operations of the particular plant, the co-operation of some technical man who is familiar with its operations and conditions, will be found exceedingly helpful. If this is not available, the accountant must himself study the conditions carefully before he attempts to design forms or even attempts to formulate his plans. A superficial view of conditions may indicate one plan, while a study of all the conditions—including the "exceptions" in the various departments—may develop the fact that another plan will fit in very much better. As a rule, any plan must be adjusted and modified to overcome the various difficulties that inevitably arise, before an effective and satisfactory working system is attained.

After the accountant has made a careful study of the plant in which the cost system is to be installed, he will undoubtedly be able to roughly outline a system which will meet the existing conditions. This system will usually require considerable adjusting and modifying before it can meet these conditions to the best advantage. Here a chart is peculiarly useful. For this use, a rough chart of the proposed plan is made. The relationships of the various forms and records are indicated.

When the draft is made, the course of procedure is carefully "tracked" from start to finish, such additions and changes as seem to be necessary being made in the chart. When this is done a second rough draft is made, possibly showing material changes, the arrangement or relationship of the various forms being so modified as to better meet existing conditions.

Under such circumstances the value of a chart as a clear, epitomized presentation of the whole system can hardly be overestimated. It brings out the practical working of the system and shows any defects in it as hardly anything else could. Frequently four or five charts will be drawn before a satisfactorily operating system is devised. When this point is reached a more convenient chart, complete in detail and perhaps more elaborate in construction, will be found advantageous. Such a chart not only serves to keep the whole system clearly before the designing accountant's mind, but assists materially in giving the factory accountants who must take charge of the system after the designing accountant leaves, the knowledge of the system necessary to its proper operation.

CHAPTER XXIX.

CHART OF ESTIMATE AND TEST PLAN.

§ 282. Records Used.

The books and other records shown on the chart accompanying the present chapter (Figure 5) are those used in the estimate and test plan of cost finding. This plan is discussed in detail in Chapter XIX of the present volume.

The following tabulation takes up in order the books and records shown on the chart. The figure number references after each show where forms of the character indicated may be found in Part VIII of the present volume. The sectional references after each show where these records or forms are discussed in the text.

(A) Purchase Analysis: Figures 52-56; § 51, and, generally Part II, "Material."

(B) Pay Roll: Figures 131, 132; §§ 68, 217, 218, and, generally, Part III, "Labor."

(C) Department Transfers: Figures 15-20, 72-74, 85, 86, 157; §§ 31, 52, 55, 56, 90.

(D) Inventory: Figures 87, 88, 91, 92; § 235.

(E) Expense Distribution: Figures 136-142, 188; §§ 94, 161, 187, and, generally, Part IV, "Expense."

(F) Factory Ledger: Any desired form of ledger can be made to intermesh.

(G) Cost Tests: Figures 21, 146, 173, 180, 193-198; §§ 31, 84, 211-213, 218, 219, 270, 277.

(H) Sales Analysis: Figures 222-230.

(I) Private Ledger: Any desired form of ledger.

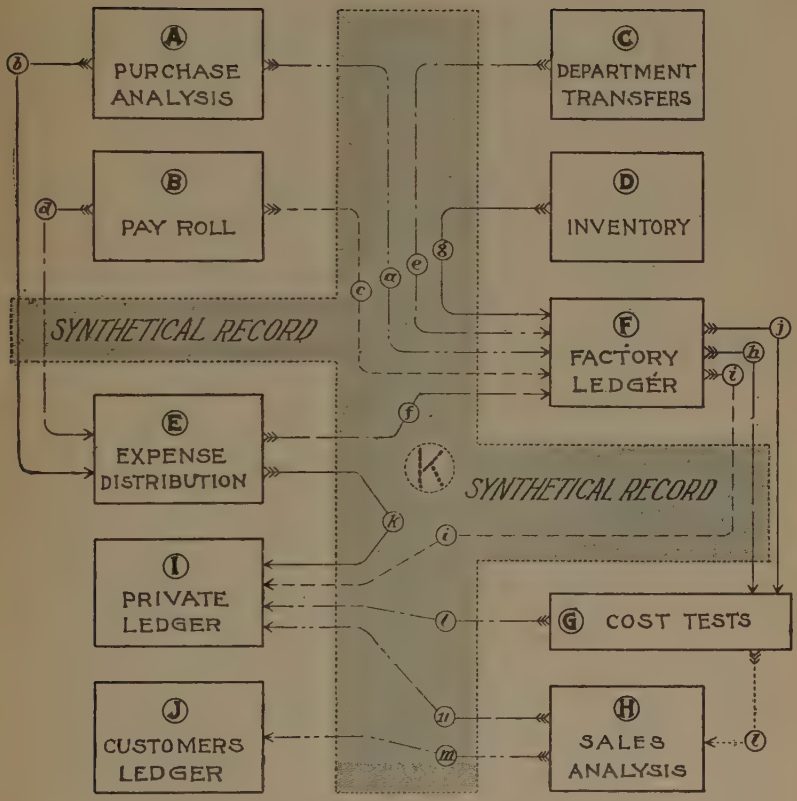


Fig. 5. Chart of Estimate and Test Plan of Cost Finding.

(J) Customers Ledger: Any desired form of ledger can be made to intermesh. Under some conditions carbon copies of invoices can be made to serve in place of ledger accounts, provided a controlling account is kept. As periodical statements are made of the customers' accounts, a manifold copy of the statement, filed in a binder, can be retained as a precautionary measure.

(K) Synthetical Record: Figures 208-218; § 51. Controlling accounts can be kept in the Factory Ledger, but a much better plan is the use of a Factory Exhibit or a General Exhibit as more fully explained in Chapter XXXIV.

§ 283. Relationship between Forms.

In Figure 5, the arrows bearing encircled italic letters indicate relationships between the forms they connect. The following references—so lettered as to identify them with the arrow relationship which they respectively discuss—set forth tersely the nature of these relationships or of entries, where entries are made. The sectional references where these appear, show where fuller explanation may be found in the text of the present volume.

(a) Material used in product is ordinarily posted from the Purchase Analysis to a "Material" account in the Factory Ledger. (§§ 51, 199). There is no special rule covering such entries, other than the general rules of double-entry bookkeeping. The more progressive factories will probably charge material purchased to departments, while still others—though following the estimate and test plan—may employ the fundamental features of a requisition system. In this case §§ 55-57 might apply.

(b) Expense items and supplies are passed to the Manufacturing Expense Account, to be later absorbed into product on a percentage basis. (§§ 161, 162, and 202.)

(c) Productive labor on the pay roll is charged to a labor account in the Factory Ledger, no time records being kept against individual jobs. It is quite advisable to have the labor account kept departmentally.

(d) Non-productive labor on the pay roll is passed to the Manufacturing Expense Account, to be later absorbed into product on a percentage basis together with items under (b) of the present enumeration.

(e) Finished parts, material, or labor items furnished by one department for another frequently are not, but properly should be, transferred on the Factory Ledger in accordance with the physical facts. (§ 56.)

(f) Expense items are divided upon an equitable basis between departments and transferred by an entry crediting Manufacturing Expense Account and debiting the several departments. (Ch. XVII.)

(g) Physical tests are periodically made of material and other goods in process accounts, and, in connection therewith, calculations are made of theoretical and actual consumption, rate of variation, etc., to the end that the figures may be used as a basis of cost estimates in connection with cost tests on individual articles of product. (§ 203.)

(h) A positive use is made of the figures arrived at under (g) of the present enumeration, in determining upon certain rates to be used in giving theoretical credit to finished product.

(i) Trading account totals are transferred to the Private Ledger without reference to production cost figures.

(j) Negative uses may be made of cost tests (not entered through a controlling account).

(k) Commercial costs are posted from the Expense Analysis directly to the Private Ledger.

(l) Rated production costs are used between the Factory Ledger and the Private Ledger.

(m) Tentative selling prices have to be used, as positive production costs cannot be known under the present plan.

(n) If interim profit and loss statements are attempted, rated profits must be used.

CHAPTER XXX.

CHART OF SPECIFIC PLAN.

§ 284. Records Used.

The books and other records shown on the chart accompanying the present chapter (Figure 6) are those used in the specific plan of cost finding. This plan is discussed in detail in Chapter XIX of the present volume.

The following tabulation takes up in order the books and records shown on the chart. The figure number references after each show where forms of the character indicated may be found in Part VIII of the present volume. The sectional references after each show where these records or forms are discussed in the text.

(A) Purchase Analysis: Figures 52, 53, 55-66; § 51, and, generally, Part II, "Material."

(B) Stores Records: Figures 10, 15, 50, 72, 80, 85, 86; §§ 39-41, 45, 56.

(C) Requisition: Figures 16-19, 67-70, 75-79, 81-83; §§ 52, 55, 56, 153.

(D) Pay Roll: Figures 131, 132; §§ 68, 217, 270, 300, and, generally, Part III, "Labor." In Figure 131 the column headed "A" is to represent productive labor and "B" non-productive labor.

(E) Labor Distribution: Figures 128-130, (131 when used in connection with the functions of a pay roll); §§ 217, 218, 243, 269.

(F) Labor Report: Figures 13, 14, 96-110, 113, 115-119, 121, 122, 128, 129; §§ 31, 60-65, 68, 212, 215, 262, 263, 265, 269.

(G) Expense Distribution: Figures 136-143, 180; §§ 94, 161, 219, and, generally, Part IV, "Expense."

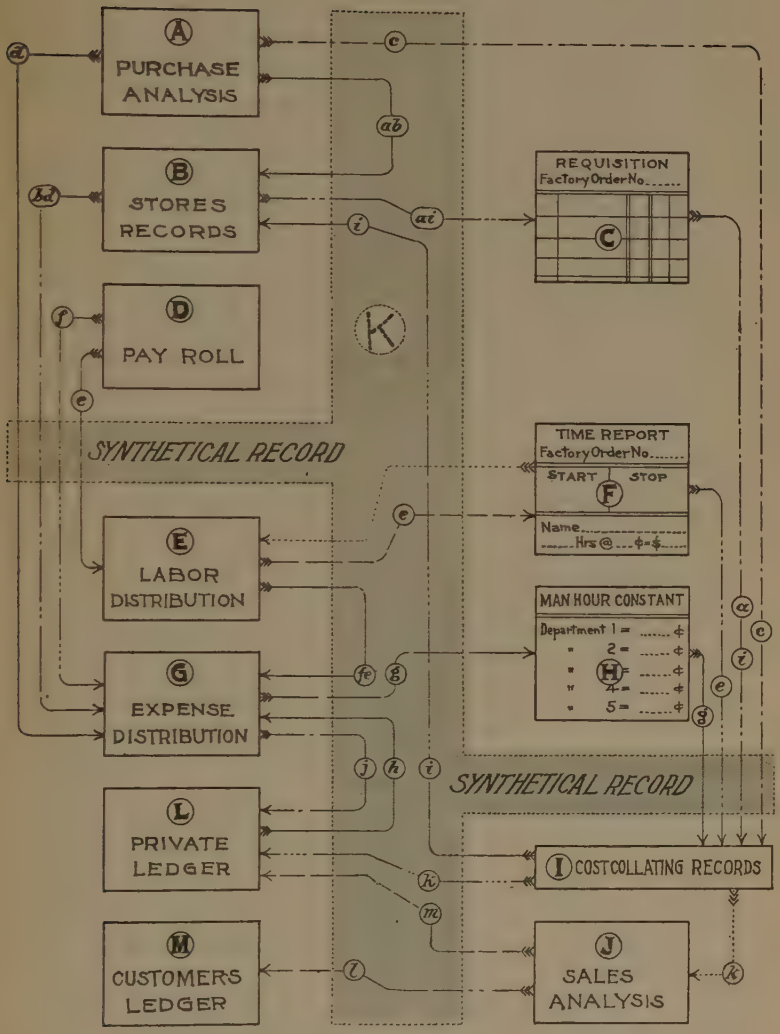


Fig. 6. Chart of Specific Plan of Cost Finding.

(H) Man-Hour Constant: Figure 143, and special column in Figures 25, 32, 34, 35, 37, 39; §§ 192, 193, 273.

(I) Cost Collating Records: Figures 21, 24-37, 158, 176, 177, 181-183, 192-198; §§ 31, 56, 212-214, 270, 271, 274, 302; Ch. XXXV. The choice of a form for showing final results or summaries of cost calculations is entirely optional with the user. Figures 159 to 175 show ideas for a few different lines of production and may serve to suggest forms for other lines.

(J) Sales Analysis: Figures 187, 188, 222-230.

(K) Synthetical Record: Figures 204-218; § 303.

Controlling accounts can be kept in the Factory Ledger but a much better plan is to use a Factory Exhibit or a General Exhibit, as more fully explained in Chapter XXXIV. It may be noticed that *all* the designating arrows pass through (K), indicating that the analytical entries are to be made within the scope of a controlling account.

(L) Private Ledger: Any desired form of ledger will intermesh; a bound book with a lock is suggested.

(M) Customers' Ledger: See (J) under § 282.

§ 285. Relationship between Forms.

In Figure 6, the arrows bearing encircled italic letters indicate relationships between the forms they connect. The following references—so lettered as to identify them with the arrow relationship which they respectively discuss—set forth tersely the nature of these relationships or of entries, where entries are made. The sectional references where these appear, show where fuller explanation may be found in the text of the present volume.

(a) Staple material purchased ahead for anticipated needs is duly accounted for by entries from the Purchase Analysis (A) to the Stock Ledger (B) until such time as part or all of such material is issued for use in product. (§ 39.)

(ai) Material issuances are made entirely upon requisitions and include both material and finished parts. Such requisitions are charged to individual production order numbers

through the Cost Collating Records (I) and in turn Stores Records (B) are given credit. (§ 55.)

(bd) Supply issuances are, like material, made upon requisition. Such requisitions are used as the basis for expense distribution.

(b) Staple supplies purchased ahead of anticipated needs are duly accounted for by entries from the Purchase Analysis (A) to the Stock Ledger (B) until such time as part or all of such supplies is issued for use in connection with the expense element. (§ 180.)

(c) Special purchases of material for specific production order numbers are accounted for by entries from the Purchase Analysis (A) to the Cost Collating Records (I), under the production order number directly concerned. (§ 51.)

(d) Purchases of expense items are charged from the Purchase Analysis (A) to the expense records, and later are directly diffused over product (§ 94), or may possibly be held in suspense and the cost be absorbed gradually over several cost periods (§ 95).

(e) Productive labor is charged against individual production order numbers on the Cost Collating Records (I). In many instances such specific time reports are also made the basis of pay-roll calculation, under which circumstances the arrow between Labor Distribution (E) and Time Report (F) is, in effect, reversed. (§§ 85, 86, 90; Ch. X.)

(f) Non-productive labor on the pay roll is charged from the pay-roll record to the expense records, and is in due course diffused over product on an equitable basis. (§ 64; Ch. VIII.)

(fe) When time of employees is divided between direct production and diffused production, the proportion devoted to each is segregated on the Labor Distribution Record (E). The cost of any such non-productive time takes the same course as described under (f) in the present enumeration. (§ 64.)

(g) Manufacturing expense items are divided upon an equitable basis between departments, and are transferred by an entry crediting the expense accumulating account, whatever its caption, and thereupon they are diffused over the various and several producing order numbers in process, by what is known as the "Man-hour Constant." (§§ 161, 162, 192.)

(h) Reserves and suspense items represent those factors of cost (1) which have not yet been paid for but which are accruing; (2) those which are not tangible but are present as deteriorating or expense-producing elements; and (3) those which have been paid for in advance but are not yet fully earned. Such items are usually carried as a negative asset or liability, as the case may be, and a portion absorbed into production each cost period by a charge from the Private Ledger (L) to the Expense Distribution Record (G). (§§ 95, 96.)

(i) Finished parts when made ahead for stock are credited to the factory records in the same manner as other product, but, pending their use, are charged to the Stores Records (B). At this time finished parts follow the course explained under (ai).

(j) Commercial costs are credited to the accumulating account, whatever its caption, and are charged to the periodical loss and gain account in the Private Ledger (L).

(k) Production costs being a known quantity, can be charged to the periodical loss and gain account in the Private Ledger (L). Such goods as are parted with in any current period are credited to "Goods in Process" or "Stores" account and charged to the monthly loss and gain account.

(l) Rational selling prices can be made under ordinary conditions of trade.

(m) Known profits can be computed in the periodical loss and gain account.

CHAPTER XXXI.

CHART OF SOLD-HOUR PLAN.

§ 286. Records Used.

The books and other records shown on the chart accompanying the present chapter (Figure 7) are those used in the sold-hour—or averaged hour—plan of cost finding. This plan is discussed in detail in Chapter XX of the present volume.

The following tabulation takes up in order the books and records shown on the chart. The figure number references after each show where forms of the character indicated may be found in Part VIII of the present volume. The sectional references after each show where these records or forms are discussed in the text.

(A) Purchase Analysis: Figures 52, 53, 57-66; § 51, and, generally, Part II, "Material."

(B) Stores Records: Figures 50, 86; §§ 37, 39, 56.

(C) Pay Roll: Figure 131; §§ 210, 216, 217.

(D) Labor Distribution: Figures 130, 179; §§ 216-218, 243, 275, and, generally, Part III, "Labor."

(E) Expense Distribution: Figures 136-142, 180; §§ 94, 210, 219, and, generally, Part IV, "Expense."

(F) Requisition: Figures 19, 67-72, 76-79; §§ 52, 55, 56, 153.

(G) Time Report: Figures 96, 98-113, 115-119, 121, 122, 128, 129; §§ 60, 61, 63, 64, 66, 68, 215, 216, 243, 262, 265, 266, 269.

(H) Cost Summary: Figure 180; §§ 210, 218, 219, 242.

(I) Job Cost Collating Records: Figures 21, 181; §§ 31, 211-214, 270; Ch. XXXV. Figures 27-30 can be used if slightly modified to fit the individual requirements.

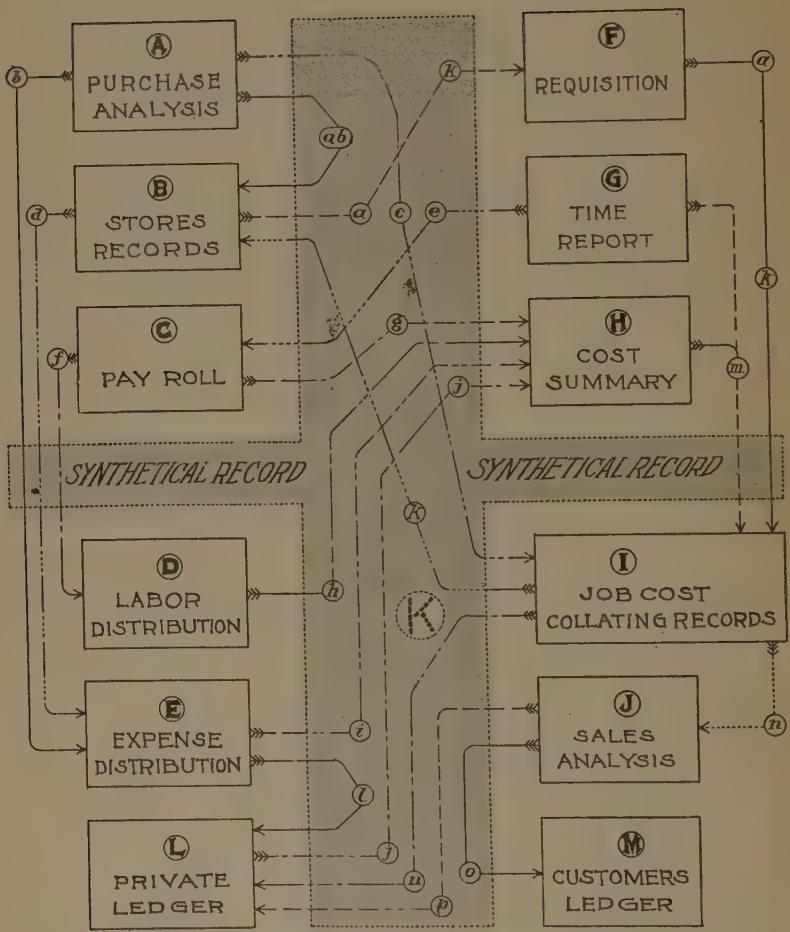


Fig. 7. Chart of Sold-Hour Plan of Cost Finding.

(J) Sales Analysis: Figure 230. Figures 228, 229 can be used, if desired, by substituting the word "Departments" for "Salesmen's Record."

(K) Synthetical Record: Controlling accounts can be kept in the Factory Ledger, but a much better plan is to use a Factory Exhibit or a General Exhibit, as more fully explained in Chapter XXXIV. It may be noticed that all designating arrows pass across the outline (K) showing that the analytical entry is to be represented in a controlling account.

For a large institution a form of General Exhibit similar to that shown in Figures 204 to 207 could be utilized to advantage by substituting the names of the several departments under the heading "Goods in Process" (Figure 206) instead of "Process," "Material," "Producing Labor," etc. (§§ 293, 295, 303.)

(L) Private Ledger: Any desired form of ledger will intermesh; a bound book with a lock is suggested.

(M) Customers' Ledger: See (J) under § 282.

§ 287. Relationship between Forms.

In Figure 7, the arrows bearing encircled italic letters indicate relationships between the forms they connect. The following references—so lettered as to identify them with the arrow relationship which they respectively discuss—set forth tersely the nature of these relationships or of entries, where entries are made. The sectional references where these appear, show where fuller explanation may be found in the text of the present volume.

(ab) Staple material and supplies purchased ahead of anticipated needs are duly accounted for—until such goods are issued—by entries from the Purchase Analysis (A) to the Stock Ledger (B).

(ak) Material issuances are made entirely upon requisition and include both material and finished parts (finished parts meaning any material to which labor has been previously added in the same plant). Such requisitions are charged to individual job numbers through the Cost Collating Records (I) and in turn Stores Records (B) are given credit.

(b) General purchases of material or expense items other than production material, are accounted for by entries from the Purchase Analysis (A) to the expense records, and when used are directly diffused over product (§ 94), or may possibly be held in suspense so that the cost may be absorbed gradually over several cost periods (§ 95).

(c) Special purchases of material or expense items for specific production order numbers are accounted for by entries from the Purchase Analysis (A) to the Job Cost Collating Records (I), under the job numbers directly concerned. (§ 51.)

(d) Supply issuances are, as in the case of material, made upon requisition only. Such requisitions are used as the basis of distribution of charges.

(e) Labor performed. The daily time reports of workmen are segregated under two classifications, hours chargeable and non-chargeable, and are so entered upon an accumulating pay-roll form (C).

(f) Segregation of hours. From the day's segregated totals on the pay roll, these totals are entered upon a labor distribution sheet (D) and at the end of the month are transferred to the Cost Summary (H).

(g) Labor costs each week are charged to the various departments, each department receiving debit for its own labor costs but no separation being made at this time as between chargeable and non-chargeable hours.

(h) Chargeable hours as a total are determined each month from the segregation on the labor distribution form (D). These are posted to the Cost Summary (H) without reference to the money cost of such hours.

(i) Manufacturing expense items are divided upon an equitable basis between departments, and transferred by an entry crediting the expense accumulating account, whatever its caption, and charging the several departments. (§§ 94, 95.)

(j) Reserves and suspense items are established for those factors of cost (1) which benefit current production but for which payment is, for any reason, deferred; (2) those which, though not seen, act to decrease values of invested assets; and (3) those for which payment has been made before complete benefit has been received. It is a quite usual practice to treat such items as liabilities or assets of a negative or offsetting value; the cost of such elements being absorbed into production by systematically setting apart a given portion each month, a charge being made from the Private Ledger (L) to the Cost Summary (H).

(k) Finished parts (process) when made ahead for stock in anticipation of future orders, are credited to the factory records in the same manner that other product is credited. They are charged to Stores Records (B) pending their ultimate use on finished product, when they follow the course explained under (ak).

(l) Commercial costs are credited to the proper accumulating account, whatever its caption, and are charged to the periodical loss and gain account in the Private Ledger (L).

(m) Sold-hour costs having been determined through the agency of the Cost Summary (H), the numbers of chargeable hours on a given job are charged to such job at the departmental time rate.

(n) Production costs, being a known quantity, can be used to charge to the periodical loss and gain account in the Private Ledger (L) such goods as are parted with in any current period.

(o) Rational selling prices can be made with a full knowledge of results.

(p) Known profits can be computed in the periodical loss and gain account.

CHAPTER XXXII.

CHART OF LIST-PERCENTAGE PLAN.

§ 288. Records Used.

The books and other records shown on the chart accompanying the present chapter (Figure 8) are those used in the list-percentage plan of cost finding. This plan is discussed in detail in Chapter XXI of the present volume.

The following tabulation takes up in order the books and records shown on the chart. The figure number references after each show where forms of the character indicated may be found in Part VIII of the present volume. The sectional references after each show where these records or forms are discussed in the text.

(A) Purchase Analysis: Figures 52, 53, 55-62, 66; § 51, and, generally, Part II, "Material."

(B) Stores Records: Figures 50, 86; §§ 37, 39, 56.

(C) Transfers, Orders, etc.: Figures 10-20, 71-74, 84-86, 157, 202, 203; §§ 31, 32, 52, 53, 55, 56, 73, 90, 223, 225, 276.

(D) Pay Roll: Figure 132; §§ 68, 217. In a slightly modified form Figure 131 can be utilized.

(E) Labor Distribution: Figure 178; §§ 216-218, 238, 274, and, generally, Part III, "Labor." If slightly modified, Figures 130 and 179 may be utilized.

(F) Expense Distribution: Figures 136-142; §§ 94, 161, 195, 210, 219, and, generally, Part IV, "Expense." In a slightly modified condition a form similar to Figure 180 can be utilized.

(G) Inventory: Figures 87, 88, 91-93, 95, 200, 201; §§ 234, 235.

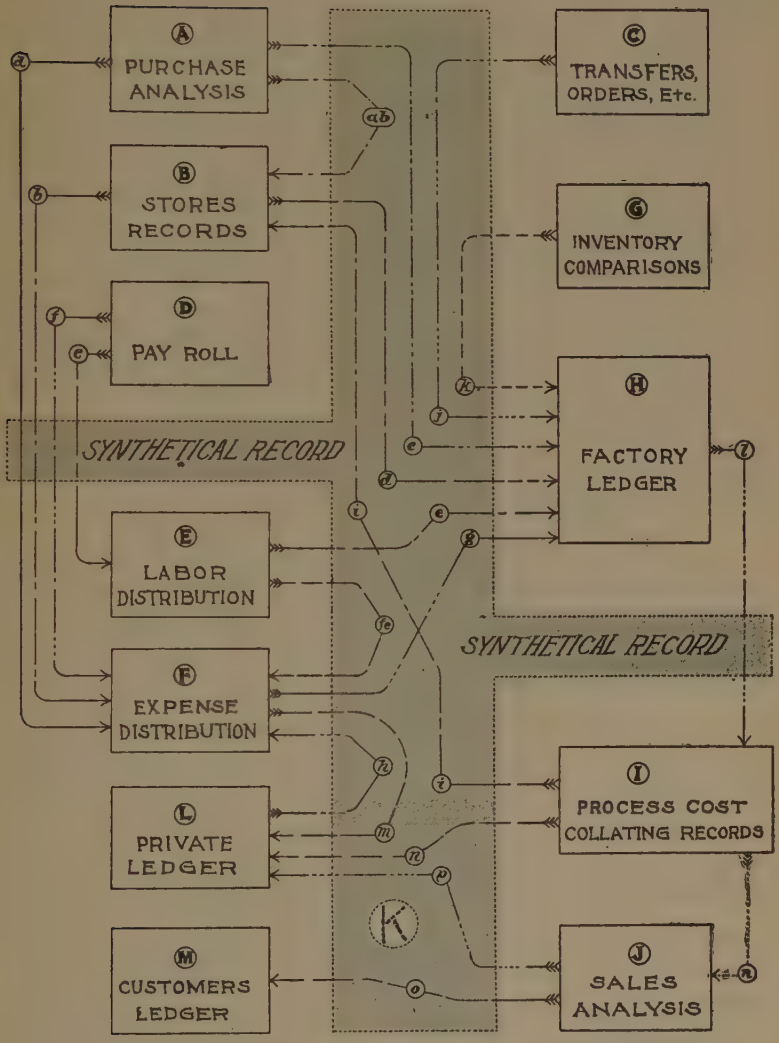


FIG. 8. Chart of List-Percentage Plan of Cost Finding.

(H) Factory Ledger: It is of minor importance what style of ledger is used. A standard form of either loose-sheet or bound book will answer.

(I) Process Cost Collating Records: Figures 38, 39, 173, 199; §§ 214, 228-233; Ch. XXXV.

(J) Sales Analysis: Figures 222-230.

(K) Synthetical Record: Controlling accounts can be kept in the Factory Ledger, but a much better plan is to use a Factory Exhibit or a General Exhibit, as more fully explained in Chapter XXXIV. It may be noticed that all designating arrows pass across the outline (K), which indicates that the analytical entry is to be made within the scope of a controlling account. (See Figures 204-218; §§ 51, 56, 231-233.)

(L) Private Ledger: Any desired form of ledger will intermesh, a bound book with a lock affixed to the covers is suggested.

(M) Customers' Ledger: See (J) under § 282.

§ 289. Relationship between Forms.

In Figure 8, the arrows bearing encircled italic letters indicate relationships between the forms they connect. The following references—so lettered as to identify them with the arrow relationship which they respectively discuss—set forth tersely the nature of these relationships or of entries, where entries are made. The sectional references where these appear, show where fuller explanation may be found in the text of the present volume.

(a) Material issuances are made entirely upon requisition and include both material and finished parts which may have been made up ahead for stock in anticipation of orders. Such requisitions are charged directly to the ledger account for the department which is benefited, no attention being given to specific order numbers upon which they are to apply. Stores Records (B) are credited.

(ab) Staple material and supplies purchased for anticipated needs are duly accounted for by entries from the Pur-

chase Analysis (A) to the Stock Ledger (B) until such time as the goods are issued.

(b) Supply issuances are, like material, made upon requisitions, which are used as the basis of distribution of charges in the Expense Distribution Form (F).

(c) Special purchases of material for certain departments are accounted for by entries from the Purchase Analysis (A) to the factory ledger account representing the particular department. (§ 51.)

(d) Purchases of expense items are accounted for by entries from the Purchase Analysis (A) to the accumulating expense records, and at the closing of the cost period are segregated over departments on an equitable basis. (§§ 94, 159.)

(e) Productive Labor. The pay roll is strictly segregated by departments and a charge for the productive labor used by each individual department is made on the Factory Ledger against the labor account of such departments.

(f) Non-productive labor is charged from the pay-roll record to the accumulating expense records (for example see Figure 141), and at the closing of the cost period it is, together with other expense items, segregated over the various departments.

(g) Manufacturing expense items are divided between departments on an equitable basis and transferred by an entry crediting the expense accumulating account, whatever its caption, and charging the departmental expense accounts.

(h) Reserves and suspense items under this plan are handled precisely the same as under the sold-hour plan (Ch. XXXI), and reference is also made to part of §§ 95, 96 of the present volume.

(i) Finished parts made ahead for stock are credited to the factory records in the same manner as other product, but pending their use, are charged to Stores Records (B). At this time finished parts follow the course explained under (a).

(j) Process, material or labor transfers are made on clearly defined records which charge the items to the department receiving the benefit therefrom, and credit the department from whence they came.

(k) Physical tests of material stores and of goods in process are periodically made. Differences are absorbed and, where necessary, rates are adjusted.

(l) Verified percentages of a standard list price are used in passing entries from the Factory Ledger (H) to the loss and gain accounts through the Cost Collating Records (I).

(m) Commercial costs are credited to the proper accumulating account, whatever its caption, and are charged to the periodical loss and gain account in the Private Ledger (L).

(n) Production costs, being a known quantity, can be used to charge to the periodical loss and gain account in the Private Ledger (L) such goods as are parted with in any current period.

(o) Rational selling prices can be made under ordinary conditions of trade.

(p) Known profits can be computed in the periodical loss and gain account.

CHAPTER XXXIII.

CHART OF MACHINE-HOUR PLAN.

§ 290. Records Used.

The books and other records shown on the chart accompanying the present chapter (Figure 9) are those used in the machine-hour plan of cost finding. This plan is discussed in detail in Chapters XXII to XXVII of the present volume.

The following tabulation takes up in order the books and records shown on the chart. The figure number references after each show where forms of the character indicated may be found in Part VIII of the present volume. The sectional references after each show where these records or forms are discussed in the text.

(A) Purchase Analysis: Figures 52, 53, 57-66; § 51, and, generally, Part II, "Material."

(B) Stores Records: Figures 10, 50, 80, 85, 86; §§ 31, 37, 39, 56.

(C) Requisition: Figures 15-19, 67-79; §§ 31, 52, 55, 56, 153.

(D) Time Reports: Figures 96-101, 104-113, 115-119, 123-126; §§ 60, 61, 63, 65, 68, 69, 212, 262, 265, 269.

(E) Labor Distribution: Figures 178, 179; §§ 216, 238, 243, 274, 275.

(F) Pay Roll: Figures 131, 132; §§ 68, 270, 300, and, generally, Part III, "Labor."

(G) Expense Distribution: Figures 136-143; 180 in a slightly modified form; §§ 94, 161, 218, 219, 242, 248, 249, and, generally, Part IV, "Expense."

(H) Term Cost: Figure 191; §§ 139, 146, 240-242, 245, 249, 250, 264.

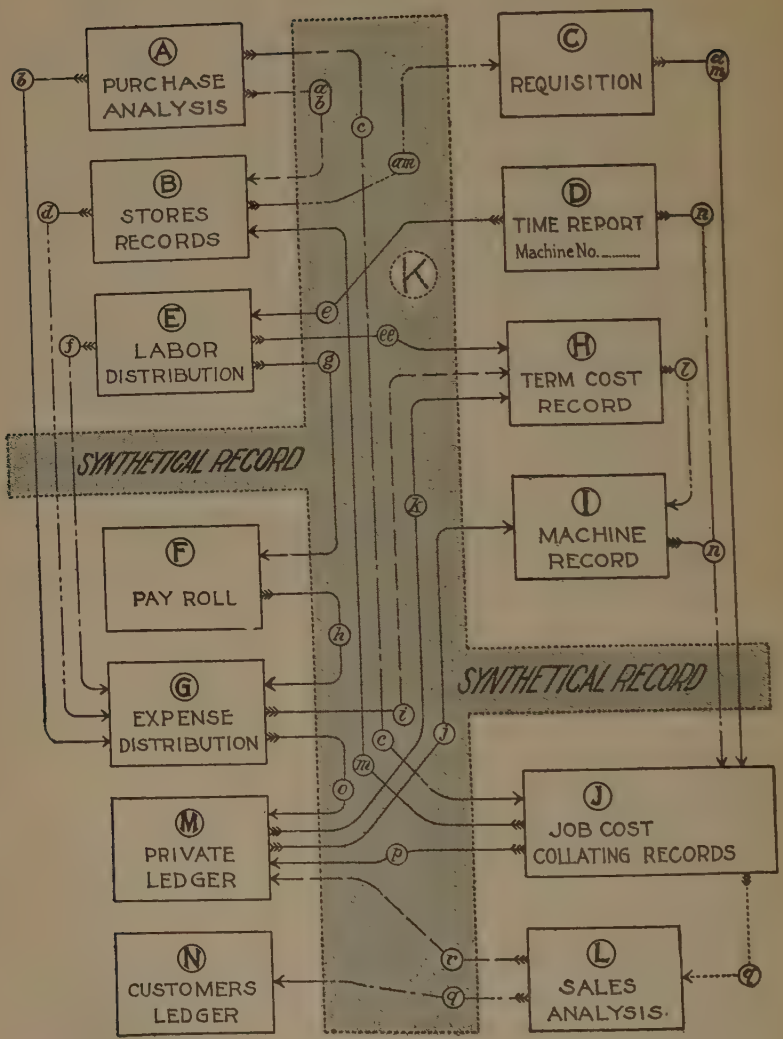


FIG. 9. Chart of Machine-Hour Plan of Cost Finding.

(I) Machine Record: Figures 178, 179, 189; §§ 118, 216, 238, 239, 243, 245, 254, 259, 270, 274, 275.

(J) Job Cost Collating Records: Figures 25, 26, 156, 174-178, 181-184, 185; §§ 56, 214, 271, 272, 274, 276; also Ch. XXXV.

(K) Synthetical Record: Controlling accounts can be kept in the Factory Ledger, but a much better plan is to use a Factory Exhibit or a General Exhibit, as more fully explained in Chapter XXXIV. It will be noticed that all the designating arrows pass through the outline (K), which indicates that the analytical entry is to be made within the scope of a controlling account. A form similar to the General Exhibit (Figures 204-207) could be used by substituting the names of the several departments of the plant under "Goods in Process" instead of the headings shown in the form.

(L) Sales Analysis: Figures 222-230, in more or less modified form.

(M) Private Ledger: Any desired form of ledger will intermesh; a bound book with lock is suggested.

(N) Customers' Ledger: See (J) under § 282.

§ 291. Relationship between Forms.

In Figure 9, the arrows bearing encircled italic letters indicate relationships between the forms they connect. The following references—so lettered as to identify them with the arrow relationship which they respectively discuss—set forth tersely the nature of these relationships or of entries, where entries are made. The sectional references where these appear, show where fuller explanation may be found in the text of the present volume.

(*ab*) Staple material and supplies purchased for anticipated needs are duly accounted for by entries from the Purchase Analysis (A) to the Stock Ledger (B) until such time as the goods are issued.

(*am*) Material issuances are made entirely upon requisition and include both material and finished parts (finished parts or "Process" meaning broadly any material to which labor has been previously added in the same plant). Such requisi-

tions are charged to individual production order numbers by means of the Cost Collating Records (J) and, in turn, Stores Records (B) are given credit.

(b) Purchases of expense items are accounted for by entries from the Purchase Analysis (A) to the accumulating expense records, and at the proper time are segregated over departments and then diffused over machines (§§ 159-196), or may possibly be held in suspense and the cost be absorbed gradually over several cost periods (§§ 95, 96).

(c) Special purchases of material or expense items for specific production order numbers are accounted for by entries from the Purchase Analysis (A) to the Job Cost Collating Records (J), under the job numbers directly concerned.

(d) Supply issuances from stores are, as in the case of material, upon requisition only. These requisitions are used as a basis for the distribution of charges to the expense records.

(e) Productive labor. The machine time reports made by machine operators carry with them the basis for calculating the pay-roll time of such operators. This time, through the Labor Distribution (E), is carried to the Pay Roll (F), the charge going to the Term Cost Record (H). (§ 243.)

(f) Non-productive labor on the pay roll is charged from the Pay-Roll Record (F) to the Expense Collating Records (G), and is, in the closing up process of the cost period, segregated over the several departments of the factory on an equitable basis, as outlined under (b) of the present enumeration.

(g) Employees' earnings. From the distribution process (E) the amounts due the several individual employees are posted to the Pay-Roll Record (F).

(h) Additional non-productive labor items that are entered on the pay roll through other channels than the Labor Distribution (E), are charged to the Expense Collating Records (G) and are ultimately disposed of as outlined under (b) of the present enumeration.

(i) Factors of cost accumulated in the expense records and including perhaps power, compressed air, fuel, gas, etc., in addition to the overhead, are all diffused over the various industrial centers on an equitable basis. (§ 241.)

(j) Space charges, interest on investment, reserves, etc., are determined at the beginning of the year, and each cost period the machine records are charged with a monthly apportionment of such costs. (§ 240.)

(k) Reserve for repairs and other items not related to the annual charges, are charged to individual machines through the medium of the Term Cost Record (H). (§ 241.)

(l) Term costs when so allocated are directly posted to the records of the several individual machines or industrial centers. (§ 242.)

(m) Finished parts when made ahead for stock are credited to the factory records in the same manner that other product is credited, but are charged to Stores Records (B) pending their final use when they follow the course explained under (am).

(n) The cost applied to production job numbers is based on the number of hours of service a given machine has been employed and the rate chargeable per hour for such machine. (§ 254.)

(o) Commercial costs are credited to the proper accumulating account, whatever its caption, and are charged to the periodical loss and gain account in the Private Ledger (M).

(p) Production costs, being a known quantity, can be used to charge to the periodical loss and gain account in the Private Ledger (M) such goods as are parted with in any current period, together with any known profits.

(q) Rational selling prices can be made under ordinary conditions of trade.

(r) Known profits can be computed in the periodical loss and gain account.

PART VII.—SUBSIDIARY AND CONTROLLING ACCOUNTS.

CHAPTER XXXIV.

THE GENERAL EXHIBIT.

§ 292. Factory Accounts and General Accounts.

Factory accounts should, as a matter of course, articulate with the general financial books of the concern. When this is the case a balance sheet may be made up from the General Ledger, or its equivalent, which will summarize the conditions of the whole business and with which all other books and records kept in the stores and warehouses and the various departments will, if the records are properly kept, agree. No matter how far the departmental subdivision of an establishment is carried, or to what extent the principle of localizing the bookkeeping be pursued, the "intermeshing" of the various records and the proper representation of all accounts in the General Ledger should be constantly kept in view.

This interdependence of the various books of account is sometimes lacking. This is so because there are still factory accountants who do not realize the obvious and material advantages gained thereby, or who do not know how to secure a harmonious "intermeshing" of the various records and accounts. To establish an independent set of books for each separate department is a simple matter for any accountant. To devise a complete system of factory accounts, sound in principle, adequate in results, harmonious in operation, and all subsidiary to one central ledger, is a science as well as an art.

Among modern cost accountants, whether in America or abroad, there is no disagreement as to the importance and

necessity of having the cost records "interlock" with the financial records. "Cost records which are not capable of being reconciled, or agreed with the actual results shown by the financial books are practically valueless, inasmuch as there can be no assurance even of their approximate accuracy. It is, therefore, an essential feature of every system of cost accounts which puts forward the least claim to completeness that the result should be capable of being—and should be—reconciled with the results shown by the financial books every time the latter are balanced."*

§ 293. Controlling Accounts.

A controlling account is one supported by subsidiary or analytical accounts. It presents in totals what is presented in other records in detail, showing at a glance the net results of the total debits and credits of its subsidiary accounts.

Thus a single Accounts Receivable Account in the Main Ledger or the General Exhibit may show the aggregate debits and credits of five hundred or more individual accounts, these latter appearing in detail in personal or subsidiary ledgers. The totals of these subsidiary accounts must, of course, agree with the totals of the main or "controlling" account. Though of almost elementary simplicity and of obvious advantage, the intentional and intelligent use of the controlling account is comparatively modern.

"Controlling accounts are absolutely essential to modern bookkeeping. Their advantages may be briefly enumerated as follows:

"1. An independent and complete trial balance may be compiled from the general ledger, whereas without controlling accounts it would be necessary to include in the trial balance all balances shown in the subsidiary records.

"2. If the general ledger trial balance is correct, the balance of the controlling account must also be correct. Then if the sum total of the balances taken from the subsidiary

*Dicksee, "Advanced Accounting," p. 248.

ledger or ledgers, as the case may be, does not agree with the balance of the controlling account, the error, or errors, will be found in the subsidiary records. Without a controlling account one would not know whether to look for an error in the general ledger or the subsidiary ledgers.

"3. When controlling accounts are used, the monthly balance sheet, and the profit and loss statement, can be supplied as soon as the general ledger trial balance is 'struck.' If an error has been made in a subsidiary ledger it may take considerable time to locate it."*

Beyond this, by means of controlling accounts the representative accounts of an extensive plant may be brought within the compass of a single ledger, and these accounts may, if desired, be still further condensed into one small Private Ledger which will then show the essential facts and conditions of an entire plant.

§ 294. Classification and Relationship of Accounts.

The controlling accounts of a business should show in clear and succinct form its operations and the condition of its various assets, from the purchase of raw material to the division of profits. In order to do this successfully there must be a most carefully classified system of records and the focused results of these records must be embodied in one book, to which all other books and records in the plan are subsidiary.

The relationship and proper classification of the various accounts of a manufacturing business are illustrated by the charts shown in Figures 1 and 2. Figure 2 is an abridged chart showing the general relations which certain classes of accounts bear to the business as a whole or to other classes of accounts of the same business. Figure 1 is a more complete chart showing all the general and analytical accounts ordinarily employed in a manufacturing business. Accounts peculiar to particular lines of production are not included. In this chart an asterisk placed after the name of an account indicates that

*Bentley, "Science of Accounts," p. 30.

it is a controlling account in connection with which an analytical ledger or some similar record is maintained for the proper detailed segregation or classification of its various items. Where an asterisk precedes a bracket it indicates that every account within the bracket is supported by an analytical or subsidiary record.

Where names of accounts appear in this chart in capital letters it indicates that they are controlling or synthetical accounts, to be supported by the analytical or subsidiary accounts which immediately follow. "Current Cash" (cash awaiting deposit) and "Bank" which also appear on the chart, may in a sense be termed controlling accounts inasmuch as other records of an analytical nature are usually maintained to support them. Accounts marked thus "†" are ordinarily kept in the Private Ledger because their entries are not sufficiently numerous to warrant setting aside columns for them in the General Exhibit. When, however, such accounts as Notes Receivable, Notes Payable, Secured Funds, etc., are sufficiently active, they may be kept in the General Exhibit.

If the records of a business are divided into the synthetical accounts shown on the larger chart and the cost records are made to properly coincide or articulate with these synthetical accounts, the accounts in their entirety present an illustrative chart of the whole business, which will disclose its condition any day, any week, or any month. (See Figure 154.) Incidentally, with such a system of accounts, the annual inventory period may be dispensed with entirely, the "going inventory"of goods of each class being verified by a physical inventory at such time as may be convenient, usually when the particular goods are at their lowest ebb.

§ 295. General Exhibit.

The General Exhibit—also frequently known as the "Balance Sheet Ledger," "Going Balance Sheet," "General Business Record," "Cash Journal," "Synoptic," "Daily Exhibit,"

etc., is a book of record designed to give a synthetical presentation of the conditions of a business as a whole. It is intended to show totals only, the details of these totals being found in subsidiary records.

The chart presented in Figure 1 shows how the details of a business are focused down by classes of accounts to general groups of accounts. These groups are represented on the General Exhibit by columns, and when the summarized results from these groups of accounts are properly entered on the General Exhibit, it becomes a "going balance sheet" of the business. If the cost system is not primarily a part of the general accounting plan, but it is desired that the accuracy of the cost records shall be subject to a form of proof by balance, the desired end may be secured by the use of the Factory Exhibit (Figures 211-218). This record is of the same general character as the General Exhibit, but is restricted to the record of factory production operations alone.

An illustrative ruling of the General Exhibit is given in Figures 204 to 207. The number of columns makes it appear as a large form, which it would be if arranged on the plan of an ordinary book. It is, however, usually constructed with wide and narrow leaves—used after the manner of master and slip sheets—so that the requirements of the General Exhibit are secured in a comparatively small space.

While the General Exhibit is in practice frequently referred to, it will not require frequent entries, as only the totals of the subsidiary records are shown on it, with perhaps an occasional adjusting entry. The plan of the General Exhibit permits its use for original entries if desired, but the results are much more satisfactory if it is relieved entirely of the details of subsidiary records.

§ 296. Opening the General Exhibit.

The columns of the General Exhibit will usually be varied, according to the requirements of the particular business,—

perhaps by the addition of columns to handle accounts, or groups of accounts, which have not already been provided for in the form shown in Figures 204 to 207; or, on the other hand, by omitting some of the columns, or merging two or more columns into one.

The General Exhibit is opened with a balance sheet of the business, so arranged as to conform to the columns of the General Exhibit. Once started in equilibrium, it must be kept in equilibrium, since for every item of debit entry there must be a corresponding entry of credit, and vice versa. The General Exhibit is the perfected idea of double entry and is complete in itself so far as being in balance is concerned. The subsidiary or auxiliary records are merely the analysis of what appears in the General Exhibit, but must—as the sum of the parts must equal the whole—always articulate with, and, as to totals, agree with the General Exhibit which contains the controlling accounts.

The General Exhibit has numerous columns, but it does not at all follow that every line must show an entry in every column. Quite the contrary, as it frequently happens in actual practice that on a particular page a number of the columns will have no entries at all, the footings carried forward to the succeeding folio being the same as those brought forward from the preceding folio.

§ 297. Keeping the General Exhibit Data Private.

By the use of a master sheet (Figure 152) and slip sheets (Figure 153), the data of the General Exhibit may be kept as private as desired. On the master sheet appear the names of the accounts or groups of accounts of the General Exhibit. On the slip sheets appear the figures. Separately the two sheets mean nothing. Together they may be made to give as complete a report of the business as desired.

To accomplish this the master sheet is folded as indicated by the dotted lines and a blank slip sheet is placed in this

fold. Upon this slip sheet are then entered the figures which in connection with the master sheet give as complete a record of the business as may be desired. Used with the master sheet the record is intelligible to any one. Without the master sheet, the slip sheet is absolutely meaningless. Should it fall into alien hands it tells nothing; but to him who possesses a duplicate of the master sheet, or a knowledge of its arrangement, the slip sheet becomes at once an open book, giving in unmistakable terms all the information intended to be conveyed.

§ 298. Closing the General Exhibit.

At the end of each fiscal period the General Exhibit should be closed by balancing the various controlling account columns after all charges and credits have been made; or, in other words, after all current entries have been made. The footings of the loss and gain accounts columns are transferred to the private ledger column of the Exhibit by a closing entry, thus absorbing the difference between the two columns which would otherwise appear as a balance. The asset and liability balances are then carried forward to the next folio and constitute the starting figures of the succeeding period.

§ 299. The Cash Account and the General Exhibit.

When the General Exhibit forms part of the accounting system it is quite essential for the best results that the "Cash Received" records be separated from the "Cash Disbursed" records. Such a separation also renders fraudulent manipulation of the cash book much more difficult and therefore less likely to occur.

The plan of handling cash shown in the chart (Figure 1) contemplates the use of a petty cash fund known as the "Imprest Fund" which is carried on the Private or General Ledger as an asset. The amount of this fund should be sufficient to provide for the current calls for ready cash during the

month or other cost period, and will therefore be determined by the conditions and practices of the particular business.

Whatever be the amount of the Imprest Fund, there should be no further charges or credits to the account on the Ledger unless it is decided to increase or diminish the amount of the fund. As current expenditures are made they are evidenced by proper vouchers and these vouchers are periodically taken up by means of a regularly issued voucher or check covering their amount, the items being then segregated and charged to the accounts to which they severally belong.

Under this plan the Imprest Fund is kept intact on the Ledger, and if audited will always disclose either the money, or its *quid pro quo* in the form of cash vouchers, bank checks, pay tickets, or perhaps entries on the Imprest Cash Disbursements Book.

Where accommodation checks are cashed from the fund, such checks should be drawn or endorsed either to "Cash" or to the name of the cashier, and not to the name of the concern.

It is hardly necessary to say that receipts in the form of currency should not be intermingled with the cash of the Imprest Fund, but should be deposited in the bank with other receipts for the day. There is, of course, no objection to an even exchange in money value between current receipts and the Imprest Fund, as for instance where smaller bills are desired in the Imprest Fund and an exchange is made with the cash of current receipts, or even where a check made to the order of the cashier, and, originally cashed from the Imprest Fund, is turned into current receipts in exchange for an equal amount of cash. When small remittances from debtors are received in postage stamps, the stamps may be purchased with money from the Imprest Fund and the transaction treated as a payment in cash.

When the cash receipts of each day or other period of time are covered into bank intact, the footings of the cash receipts sheets can be kept in exact articulation with the bank's

record of the transactions, thus minimizing any possible danger of manipulated figures. The entry on the General Exhibit when a deposit is made, is to credit cash and debit the bank, the debit entry coming under the proper bank if there is more than one depositary.

In the practical operation of the General Exhibit it is not absolutely necessary to give an entire line across the page to the entry of the deposit each day for the reason that the cash and bank columns are in juxtaposition and figures entered therein are self-evident of their purpose. Hence a deposit entry can be made on the same line with another entry of the same date, provided this other entry does not use the deposit column. Nor, indeed, is it absolutely essential that every entry on the line be of the same date, if the proper date be interlined immediately before or after the figures of the amount of the deposit. This suggestion is a departure from theoretically correct practice, and is only allowable as a measure of economy and when it does not tend toward obscurity in any entry to even a slight degree.

Theoretically the cash receipts sheets (Figures 219) and the check register sheets (Figure 220) should be footed and the footings be transferred each day to the General Exhibit. In practice, however, the daily transfer is not usual except where the sheets involved are quite numerous.

Also, as a matter of practice, when financial reports (Figures 152 to 154) are made, the totals of those records which, theoretically, should go on the General Exhibit daily, but which in practice are not so entered until the end of the week or month, can be assumed to be entered, and, to make this effective, the pencil footings to date on such auxiliary records be added to the figures that are actually on the General Exhibit. In cases involving a large number of items this practice is not feasible, and the General Exhibit must then each business day absorb the totals of all auxiliary records that can be run on a daily basis.

CHAPTER XXXV.

THE PRODUCTION REGISTER.

§ 300. Function of the Production Register.

The Production Register (Figures 31, 32) is in effect an exhibit of every producing department, showing for each the total amount of material used and the total production labor costs. In the case of labor costs a comparison can be made with the totals of the production labor column of the pay roll (Figure 132), thus establishing the accuracy of both.

It is sometimes advantageous to arrange the ruling of the Production Register so as to allow from three to six lines for each production order, on which its cost items may be properly posted. It is usually better, however, particularly where time recorders are used, to collate all the charges for labor and for material upon a sheet specially ruled for the adding machine, and enter them by totals on the Production Register. There will then be no entries on the Production Register until the end of the current month or cost period, save when, in the interim, costs are desired on the conclusion of some particular order.

Even when "interim" costs are desired it is not essential that the cost figures be entered on the Production Register before the end of the month or cost period, as the results may be obtained equally well by the use of a memoranda sheet. The Production Register is not designed for quick reference to the costs of particular order numbers, but is intended primarily for the collating or assembling of the different cost figures into a complete whole, thereby securing a total of all orders in a particular department for statistical and comparative purposes and for entry on the general books.

§ 301. Debits of the Production Register.

The debit charges of the Production Register should be entered at the close of each month or cost period. At this time the cost cards which have accumulated under the various order numbers during the period, are removed from the files of each department. One order number at a time is taken up and the respective cards for finished parts, materials, machine time, labor, and "transfer," belonging to that order number are, for each department, separated into individual piles. Then, with the exception of the transfer cards, each class is in turn totalled on the adding machine.

For this purpose a large sheet of paper properly prepared is inserted in the adding machine and the order number is typed or written at the head of the sheet. The operator then takes the cards coming from the department in which the particular order number was put in work. The finished parts cards are first selected and the total money value which each card represents is listed upon the sheet under the first column heading "Finished Parts." The operator also shows upon the sheet where possible, the time clock number of the man who used the goods called for by the card. The column is totalled when all the finished parts cards have been listed, the footing showing the money value of the finished parts used.

The operator then proceeds in like manner to list the other cards. In the case of machine time or labor cards the operator will—if a "split" adding machine is used—list the workman's clock number, the hours and minutes involved, and the money value of the time; the totals then showing the full time consumed on the particular order number and the money value of this time.

Having finished listing the data from the first department, the cards of the same order number in each succeeding department are treated in like manner, so that on the conclusion of the operation the adding machine sheets will

show all the prime departmental costs of a given shop order, grouped in one place and susceptible of a grand total if desired.

When all the cards of the various shop order numbers for the cost period have been listed, the totals for all the departments of each classification are entered in the proper columns of the Production Register on the lines devoted to the particular order number.

Diffused expense against each individual order in each department, as explained in § 187, is entered in the proper column of the Production Register. The total of the diffused expense column of each department must exactly articulate with the expense charge against that department.

All the debit columns of the Production Register must agree with the equivalent debits in the synthetical accounts of the General Exhibit.

§ 302. Credits of the Production Register.

The credits of the Production Register cannot be proved by comparison with the entries of the General Exhibit, as in the case of its debits, the General Exhibit containing no equivalent accounts.

Credit is given to "Goods in Process" in the Production Register when individual orders are completed. To do this the total respective costs by departments, of finished parts, raw material, machine time, direct labor, direct expense, and diffused expense, charged to such order number (see Figures 25, 26), must be determined. These several totals covering perhaps one or more months are then entered under the corresponding credit columns of the Production Register, the individual totals thereafter being shown as an offsetting debit in one or another of the columns headed "Finished Parts," "Finished Product," "Other Departments," or "Other Accounts," according to the nature of the finished order.

The bookkeeper will get his monthly or periodical credit entry for Goods in Process by means of a recapitulation sheet

made up from each monthly sheet of the Production Register. The offsetting debit will be taken from the totals of the distribution columns. The "Other Accounts" can either be secured by individual postings, or the column may be analyzed and the totals for each separate account be shown on the recapitulation sheet.

At the close of each month or period, the net value of each order in process will be carried to the right-hand side of the sheet to the column headed "Value of Goods Still in Process." The grand total of such columns embracing all departments should exactly equal the net amount shown under "Goods in Process" in the General Exhibit.

In cases where the Production Register is not provided with distribution columns for the classification of finished or semi-finished product, but all classes of product are included in one column, such entry will have to be made upon the General Exhibit from the credits as shown on the Production Register, which must, of necessity, be analyzed.

§ 303. Goods in Process Accounts.

The "Goods in Process" group of accounts (General Exhibit, Figures 206, 210, or the Factory Exhibit, Figures 211, 213, 217, 218) is perhaps the most important group in the general plan of the cost system, if one can be classed as more important than another where each and all are necessary to the finding of actual costs. They are the controlling accounts of the General Exhibit, which both in theory and in fact "articulate" more closely with the Production Register than do any other records.

A mistake in a goods in process account is more serious than a mistake in almost any other account, since it means a wrong cost computation on some particular part of product. On the other hand, the possibility of error in the goods in process accounts is not as great as in some other accounts, because primarily of the greater care taken with these more important

accounts and because the origin of entries is so nearly alike in both the Production Register and the General Exhibit that a ready proof by balance is at hand.

Figures 36 and 37 show a form of record for registering only credits to goods in process. This record is used for "short-time" product, i. e., product quickly made up. It is in effect a combination of a "Cost of Product" Register and the ordinary Production Register. On it is shown the cost of all goods made up for or shipped from stock to customers. If the goods are on hand their cost is entered in the column headed "Finished Product, Cr." (Figure 37), the offsetting debit going to "Profit and Loss (Cost of Goods Sold)."

Under this plan *charges* to goods in process are not made in the Production Register and are not segregated in material, labor, and expense accounts at all, but are treated by totals only—pay roll, material, withdrawals, etc.—and that in the General Exhibit under the Goods in Process Account.

As each separate order for special production is completed the cost cards are taken from the assembling files, are added on an adding machine, and the total of elements credited to Goods in Process (Figures 36, 37), the offsetting charge going to "Profit and Loss (Cost of Goods Sold)"; or, if it be goods manufactured for stock, to Finished Product.

Under this plan it is not as easy to prove the accuracy of orders in process as in the case of the plans previously described.

§ 304. Form of Production Register.

Figures 31 to 34 show forms of the Production Register which can be used exactly as described, or, with which, if desired, series of slip sheets (Figure 35) can be used for each succeeding month after the first. The slip sheet plan is desirable in factories where certain order numbers run over a series of months, as it saves rewriting the descriptive data each month. Also by the use of slip sheets a ready refer-

ence statement is at hand at all times for the figures of the given order number.

The slip sheet is in all important details similar to the master sheet—which is the printed page of the Production Register—save that it can be ruled and printed for use on both sides, whereas the master sheet can be used on but one side owing to the manner in which it is used with its slip sheets.

Figures 27 to 30 show a plan of Production Register to be used when the material is not issued in predetermined quantities, but a certain amount is issued and the unissued portion credited back. Under this plan the costs are posted from requisitions, time reports, etc., directly to the Production Register. Figures 27 and 28 represent the face, and Figures 29 and 30 the reverse of the sheets.

§ 305. The Production Analysis Key and the Analysis Sheet.

Figure 24 shows a production analysis key sheet and Figures 25 and 26 an analysis sheet used in connection with the key sheet. These are employed where more or less secrecy is desired concerning cost figures. The first form, the Production Analysis Key, is a private book to be kept in a lock binder by a confidential clerk. This book shows the consecutive order numbers, a brief description of the order, whom it is for, and provides spaces for a record of deliveries. Each line of the book bears a printed number which corresponds with a line number on the analysis sheet.

The sheets of the Analysis Key are numbered from one upward. The analysis sheets are also given numbers—these numbers corresponding to those of the master sheet—as they are brought into use. There may be almost any number of the analysis sheets to one key sheet, for the reason that the key sheet may represent either one month or a number of months, while a separate analysis sheet (corresponding to its master or key sheet) is required for each department for each

consecutive month. Each analysis sheet, therefore, also bears a progressive letter to show its month, together with the number of the department to which it belongs.

Thus, as illustrating the use of the key and analysis sheets, the key or master sheet bearing the number 15 may have several months' accumulations of analysis sheets in use. Each of these analysis sheets will also bear the number 15 to show the page of the Analysis Key to which it belongs, will bear its department number, and in addition to this a progressive letter to indicate the month covered by the particular slip sheet. Thus, the sheets for department 1 are numbered and lettered for the first month "1a," for the second month "1b," etc., while the similar sheets for department 4 are numbered "4a," "4b," etc.

§ 306. Repair Orders.

In plants where a considerable number of repair parts are sold, repair orders are usually quickly finished up and shipped, and it is quite unlikely that there will be many open or unfinished orders on a key sheet at the close of any month or period, except on a sheet that happens to have been started but a short time before the closing period. If there are only a few unfinished orders on a key sheet at the end of a period, it is better to transfer these unfinished orders to a new key sheet rather than to keep alive the old sheet with its connected analysis sheets.

In the operation of this plan of Production Register it will be found expedient to confine certain of the sheets to repair orders, and certain other sheets to stock orders (semi-finished product prepared for stock), and certain other sheets to finished product. In this way each series of order numbers is kept consecutively without break except as between sheets. Also the analysis sheets for orders, such as repairs, which are quickly filled, will soon be retired, while orders for finished product and others which require some time for completion

can be carried on the same sheet for some two or three months without change, if found expedient.

The master sheet shows the month in which it was started, and in the following space the month in which it was completed. These master sheets are placed in the current holder and are subsequently filed in a transfer binder by progressive sheet numbers. It will eventually result, therefore, that each series of order numbers will be preserved seriatum. When any order number is carried forward to a new sheet, the number of the original sheet, i. e., the sheet from which such an order number is forwarded, is not shown on the new sheet for the reason that the column headed "Date Ordered" will disclose the fact that such order has been forwarded from another sheet and it is then a simple matter to refer to the serial location of such order number. On the other hand, when an order number is carried forward from one sheet to another, the number of the second sheet is shown on the first sheet under the column headed "Forward to Sheet No. ——."

PART VIII.—FORMS.

CHAPTER XXXVI.

TREATMENT OF FORMS.

§ 307. General.

Illustrations of the more important forms used in cost accounting are presented in the following chapters of Part VIII. Most of these forms have already been considered and where this is the case the numbers of the sections in which they are discussed follows the title of the form. Where all necessary explanation of any form has not already been given, a brief comment under the number of the particular form will be found in the first part of the chapter of Part VIII in which the form appears.

Figures 1 to 9 inclusive of the forms of the present volume do not appear in Part VIII. These forms and their respective location are as follows:

Figure 1, Unabridged Chart, showing the classification of the accounts of a manufacturing business. This chart will be found in the front of the present volume—between fly-leaves and cover—and is discussed in §§ 294, 295.

Figure 2, Abridged Chart, showing the more general relations between the various accounts and between these accounts and the business. This chart immediately precedes Chapter I of the present volume.

Figures 3 and 4 are charts showing how production costs are built up; chart 3 showing the percentage of costs accruing as the product passes through the various departments, and chart 4 showing the composition of

production cost by cost elements. Both these forms are found in Chapter XXI.

Figure 5 is a chart of the estimate and text plan of cost finding, presented in connection with Chapter XXIX.

Figure 6 is a chart of the specific plan of cost finding, presented in connection with Chapter XXX.

Figure 7 is a chart of the sold-hour plan of cost finding, presented in connection with Chapter XXXI.

Figure 8 is a chart of the list-percentage plan of cost finding, presented in connection with Chapter XXXII.

Figure 9 is a chart of the machine-hour method of cost finding, presented in connection with Chapter XXXIII.

§ 308. Size of Forms.

The forms presented in Part VIII of the present volume do not show their relative sizes. Where parts of a form are shown in separate but related cuts, these parts are, as a rule, on the same scale, but otherwise the forms presented have been reproduced regardless of relative sizes, the only end striven for being the clearest possible presentation of the form within the available space.

For help in constructive work, a suggested size for the form is noted in each case below the form itself, and this in connection with the cut should give a sufficient working idea of the form.

§ 309. Use of Forms.

The majority of the forms presented in Part VIII have been devised for special systems in particular factories. As a rule, a form well adapted for use under the particular circumstances for which it was devised, cannot be used under other circumstances without more or less adaptation. It is obvious that the cost-finding plan must not be stretched to fit special forms, merely because these forms are at hand, but that the forms must be modified to meet the requirements of the system. This will be found true with most of the forms shown in Part VIII. The necessary changes may, however, be read-

ily made, the forms presented giving an effective basis for such alterations. In many cases, perhaps the only change will be the substitution of headings, or the addition or elimination of columns. When once the method in which a particular form is used is clearly understood, its proper adaption to a particular system is a simple matter.

§ 310. Construction Details.

As a practical suggestion it may be said that if a few simple general rules as to color ruling are observed in the preparation of forms, their use will be much facilitated. Thus where columns are grouped, the groups should be separated by rulings of distinctive color, such as purple, or a triple ruling of red and blue. Also the character of certain columns may be denoted by the color of their rulings. Thus all columns for the entry of debits may be ruled with a double blue line at the left of the column and with a single blue line between dollars and cents and between hundreds and thousands. In like manner all columns for credit entries may be ruled at the left-hand side with double red lines, and with red lines between dollars and cents and between hundreds and thousands.

For columns in which the entries are neutral, being neither debit nor credit, such as reference numbers, weights, etc., the separating ruling should be green or some color other than blue or red.

If this practice is systematically followed, it is possible to tell at a glance without really looking at a column heading, whether an entry is being made in a debit or a credit column. Moreover, on large folios it is much easier to follow down a certain column with the eye when this column is distinguished by a characteristic ruling as suggested.

CHAPTER XXXVII.

PRODUCTION ORDERS AND RECORDS.

§ 311. Comment on Forms of Chapter.*

Figure 10. Stores Order. This is an order for parts of semi-finished product to be made up in advance for stock or to supply current needs. Its general form is that of a tag upon which appear the details of the goods to be made up. This tag is attached in the ordinary way to one of the pieces of its lot and follows the job through the various operations.

When the job is completed the goods are inspected—usually by the foreman—and the inspector punches the cost-room coupon of the stores order form with an identifying punch. The goods then go to the stock-keeper, who receives them and records on the cost-room coupon the number of pieces he has received. He then punches the coupon with his identifying punch, detaches the cost coupon, and turns it over to the cost department.

When once the cost coupon has been detached, workmen are not given credit for any further time shown against its job or shop order. (See also §§ 31, 56.)

Figures 11 and 12. Indeterminate Order. The purpose of this form is to record goods passing through one operation or department to another operation or department. It is employed more particularly when the work done is of a continuous nature and when the number of pieces must be strictly accounted for. Figure 11 shows the form, and Figure 12, which is its reverse side, shows the instructions to workmen

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 312.

regarding its use. The practice is to issue one indeterminate order blank each week, or oftener if the blank is sooner filled up. This is done for the purpose of keeping a close check on production. (See also § 31.)

Figure 13. Garment Working Order—with single coupon. This form is used in wholesale tailoring, but the same idea may be employed to advantage in many other lines of production. The number of orders provided for on a page is entirely discretional. In the form shown each order represents a three-piece suit. Two-piece suits would be entered on another sheet or book of similar characteristics. In use the form is filled out in manifold, the carbon impression on an unperforated sheet remaining intact in the binder as a matter of permanent record. The pay coupon of this form is described in § 31.

Figure 14. Garment Working Order. When the coupons of this form are small, the employees equip themselves with a small but wide-necked bottle into which the coupons are dropped as they are clipped. On the form as shown there is no method of identifying a given coupon with the corresponding order number. Where such identification is necessary it can be provided for by means of wider coupons, on the reverse of which is printed in condensed style the following line of figures:

1928374655647382910019283746556473829 10ABCDEFG

The lines on the different coupons must "register" accurately, so that any particular figure in one line is exactly over, or under the corresponding figure in every other line. Then, with the use of a ruler, an order number of at least four figures can be indicated by drawing a single line at one operation through the desired figure on all the coupons, red ink being used preferably, so as not to obliterate the indicated figures.

For instance, the order number is 8943. Four red lines are then drawn down the entire length of the strip of coupons, indicating successively the figures crossed. The letters

A to G show how other distinguishing characters can be inserted on the coupon, to be used in the same manner as the figures.

Figure 15. Cutting Order. This form is employed where usable scrap results, and is explained more fully in §§ 31 and 90. As shown it is for use with lumber, but the same principles enter into the cutting of many other kinds of material where the same general conditions prevail. In some cases it is possible to determine and record in advance the amount of waste on each individual job. Thus in the case of upper stock for shoes, there is a device on the market for calculating the minimum amount of leather ordinarily required to cut such a number of pairs of shoes of varying sizes and widths as shall be registered or "set" on the indicating mechanism. Where this device is used, a clerk calculates each order in succession and records the amount of the leather to be issued to the cutter. The cutter's ability is then gauged by his record on the successive orders. At times a cutter will do better than the machine "allowance," while others will frequently run behind the machine and need more than the indicated stock to fill out orders.

Figure 16. Mass Production Order. The form shown in Figure 16 is adapted for use with paint, but the same idea is used in many other lines of production where a given article may be put up in several different sizes or shapes of container. The form is more fully discussed in §§ 31 and 55.

Figure 17. Container Order. This form can be used for any kind of product or any kind of containers. It is more fully discussed in §§ 31, 32 and 55.

Figure 20. Production Order—standard parts. This form of production order is usually in sets composed of a sheet for each department. The date, product, designating number, and quantity are put on all sheets simultaneously by means of carbons. In some cases the schedule time for leaving each department is embodied in the form.

Figure 23. Production Order—standard operations. This form is peculiarly adapted for either time-work or piece-work under the machine-hour plan.

Figures 27 to 30. Production Order Register. When this form is used, all departments are included in one folio, the left and right side of sheet being respectively the face and reverse side of the page. The form is discussed at greater length in § 214.

It may be said in this connection that when loose-leaf sheets are to be used in a binder, a form being spread on two sides of the same sheet—face and reverse—such sheets must usually be worked with other similar sheets so that the reverse side of one sheet forms the left-hand portion of a folio of which the face of the following sheet forms the right-hand portion. Each sheet then becomes part of a logically but not physically inseparable record.

Figure 35. Slip Sheet—used in juxtaposition to the master sheet in Figures 33 and 34. These sheets are used for the successive months during which their orders are in process.

Figures 36 and 37. Individual Department Sheet—left and right side. Used where orders do not ordinarily require a long space of time for completion.

§ 312. Forms of Production Orders and Records.

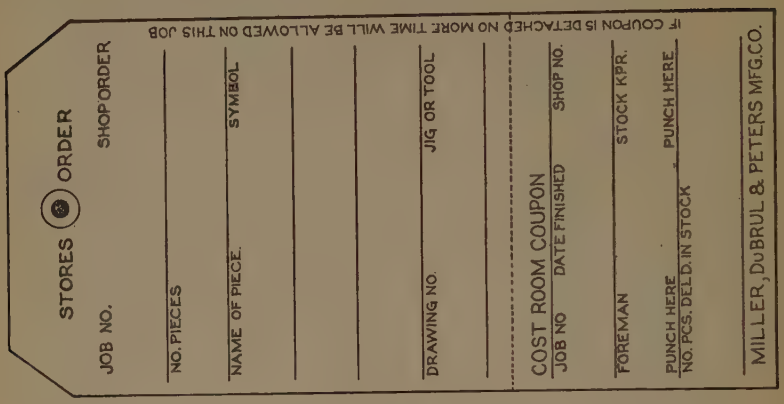
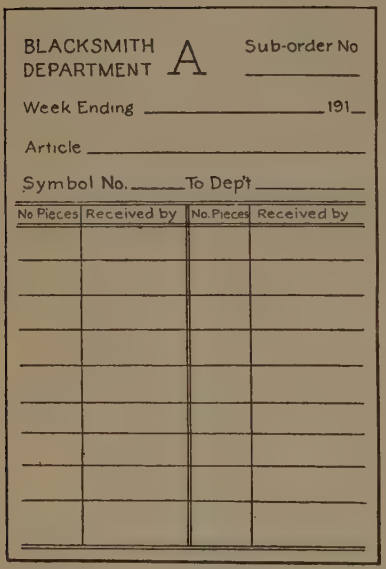


Fig. 10. Parts Order for Stores. (See §§ 31, 56, 311.)
Suggested size, 6½"x3¼".



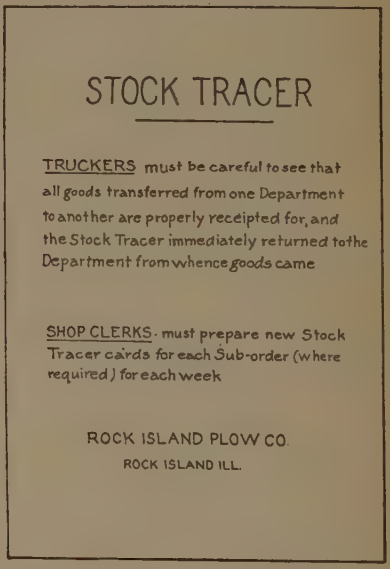

STOCK TRACER
TRUCKERS must be careful to see that all goods transferred from one Department to another are properly receipted for, and the Stock Tracer immediately returned to the Department from whence goods came
SHOP CLERKS must prepare new Stock Tracer cards for each Sub-order (where required) for each week
ROCK ISLAND PLOW CO
ROCK ISLAND ILL.

Fig. 11. (Left) Indeterminate Order—Front. (See §§ 31, 311.)
Fig. 12. (Right) Indeterminate Order—Back. Suggested size, 4"x6".

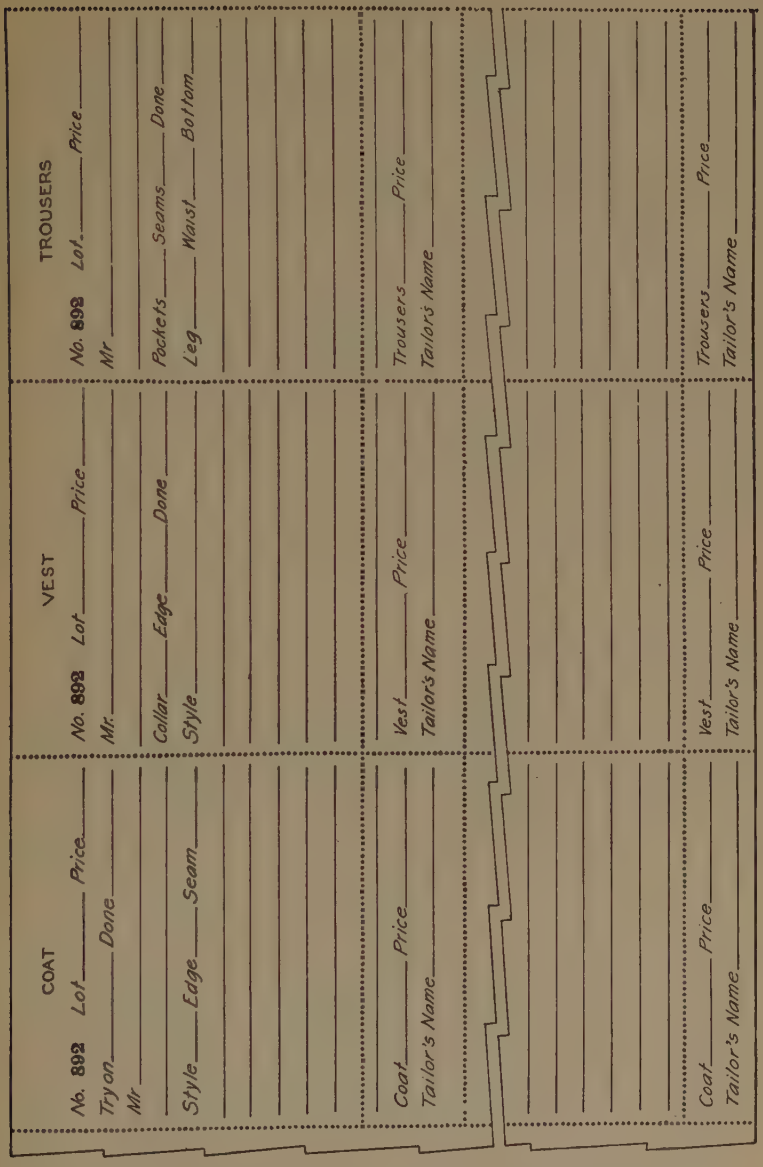


FIG. 13. Garment Working Order. (See §§ 31, 311.) Suggested size, 13″x3 orders deep (15″).

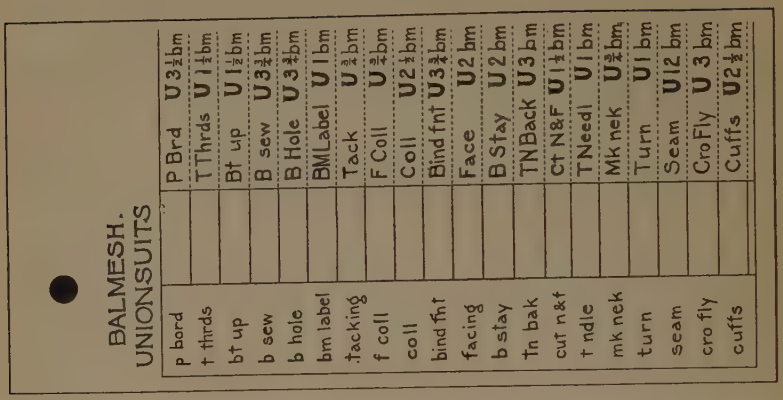


Fig. 14. Garment Working Order—Operation Coupon. (See §§ 31, 311.)
Suggested size, 2″x4″.

THE KILBOURNE & JACOBS MFG. CO
LUMBER AND MILL WORKING ORDER

SHOP ORDER NO. _____ DATE _____ 191__
FOR _____

SHOP RECORD		LUMBER YARD RECORD						OFFICE		SHOP	OFFICE RECORD			
PIECES	NET SIZES REQUIRED	KIND	PILE NO	GRADE 1ST & 2ND	GRADE LOG RUN	GRADE COMMON	GRADE CULL	PRICE	EXTENSION	CUTTING MEMO.	MEMO	NET FEET AGE	PRICE	EXTENSION

THIS CARD MUST BE RETURNED WHEN ORDER IS COMPLETED.

FILLED BY _____ WORKMAN NO. _____ _____ FOREMAN

Fig. 15. Wood Working Order. (See §§ 31, 90, 311.)
Suggested size, 9½″x6″.

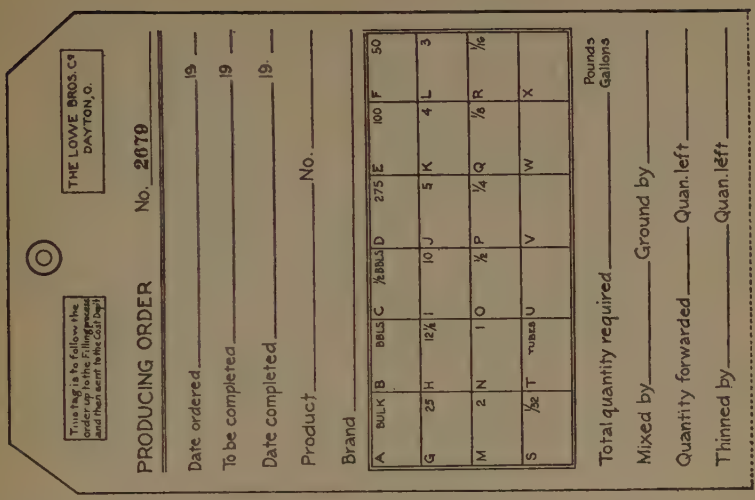

THE LOWE BROS. Co
DAYTON, O.
This tag is to follow the order up to the Filling-room and then sent to the Cost Dept.
PRODUCING ORDER No. 2679
Date ordered 19
To be completed 19
Date completed 19
Product No.
Brand
A BULK B BBLS C ½BBLS D 275 E 100 F 50
G 25 H 12½ I 10 J 5 K 4 L 3
M 2 N 1 O ½ P ¼ Q ⅛ R 1/16
S 1/32 T TUBES U V W X
Pounds
Gallons
Total quantity required
Mixed by Ground by
Quantity forwarded Quan. left
Thinned by Quan. left

Fig. 16a. Bulk Paint Production Order—Top. (See §§ 31, 55, 56, 311.)

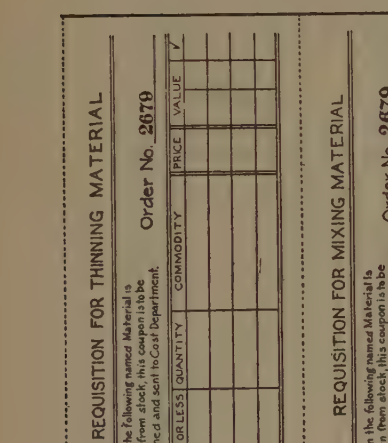

REQUISITION FOR THINNING MATERIAL
When the following named Material is drawn from stock, this coupon is to be detached and sent to Cost Department.
Order No. 2679
MORE OR LESS | QUANTITY | COMMODITY | PRICE | VALUE | ✓
REQUISITION FOR MIXING MATERIAL
When the following named Material is drawn from stock, this coupon is to be detached and sent to Cost Department.
Order No. 2679
MORE OR LESS | QUANTITY | COMMODITY | PRICE | VALUE | ✓

Fig. 16b. Bulk Paint Production Order—Bottom.
Suggested size, complete form, 4¾"x13½".

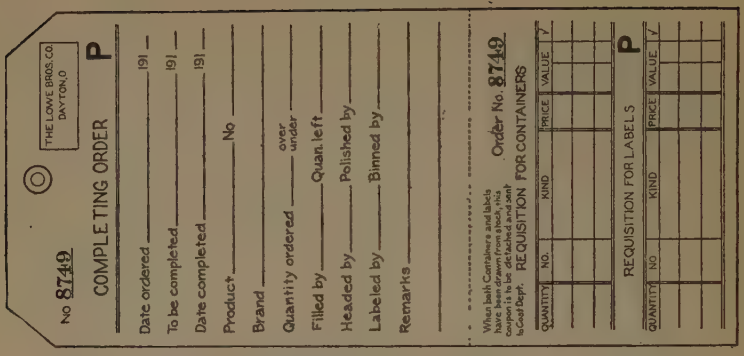

THE LOWE BROS. CO.
DAYTON, O
No 8749
COMPLETING ORDER P
Date ordered ____ 191 —
To be completed ____ 191 —
Date completed ____ 191 —
Product ____ No ____
Brand ____
Quantity ordered ____ over under
Filled by ____ Quan. left ____
Headed by ____ Polished by ____
Labeled by ____ Binned by ____
Remarks ____
When bath Containers and labels have been received, this order should be filled out attached and sent to Coast Dept.
Order No. 8749
REQUISITION FOR CONTAINERS
QUANTITY | NO. | KIND | PRICE | VALUE
REQUISITION FOR LABELS P
QUANTITY | NO. | KIND | PRICE | VALUE

FIG. 17. Paint Container Order. (See §§ 31, 32, 55, 56, 311.) Suggested size, 4¼"x9".

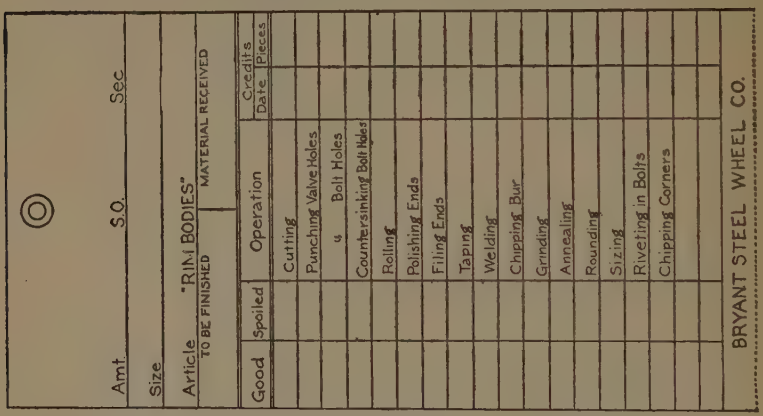


FIG. 18a. Steel Wheel Order—Top. (See §§ 31, 56.)

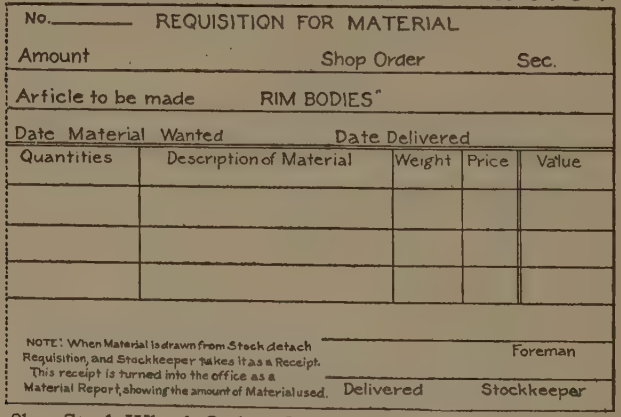

No.____ REQUISITION FOR MATERIAL
Amount
Shop Order
Sec.
Article to be made RIM BODIES"
Date Material Wanted
Date Delivered
Quantities | Description of Material | Weight | Price | Value
NOTE: When Material is drawn from Stock detach Requisition, and Stockkeeper takes it as a Receipt. This receipt is turned into the office as a Material Report, showing the amount of Material used.
Foreman
Delivered
Stockkeeper

FIG. 18b. Steel Wheel Order—Bottom. Suggested size, 4"x13½".

A. A. SIMOND & SON, MACHINE KNIVES, DAYTON, OHIO.

Before Starting Work, Read Carefully

ORDER No. _____ Date _____

Kind and Number

Length Width Thickness Temper

Bevel

Depth and Width Slot

ORDER No. Kind, Number and Size

MATERIAL		ORIGINAL AMOUNT	AMOUNT USED	SCRAP	MATERIAL	ORIGINAL AMOUNT	AMOUNT USED	SCRAP
CAST STEEL	A				WOOD			
	B				THIN IRON			
	C				SOFT STEEL			
	D				BAR STEEL			
	BAR				SHEET STEEL			
LAID STOCK	PLANER				IRON { REFINED			
	PAPER				{ COMMON			
	CHAIR LEG				MISCELLANEOUS			
	BUILT UP							
	BARS							

FIG. 19. Machine Knife Order. (See §§ 31, 56.) Suggested size, 8″x7″.

THE ALPINE SAFE COMPANY

Dep't _____ HINGE MAKING

DATE _____ 19__ No. 169

PART _____ SYMBOL _____

SAFE NO. _____ QUANTITY _____

MATERIAL NEEDED _____

DELIVERED _____ TO DEP'T _____ ON REQ'N No. _____

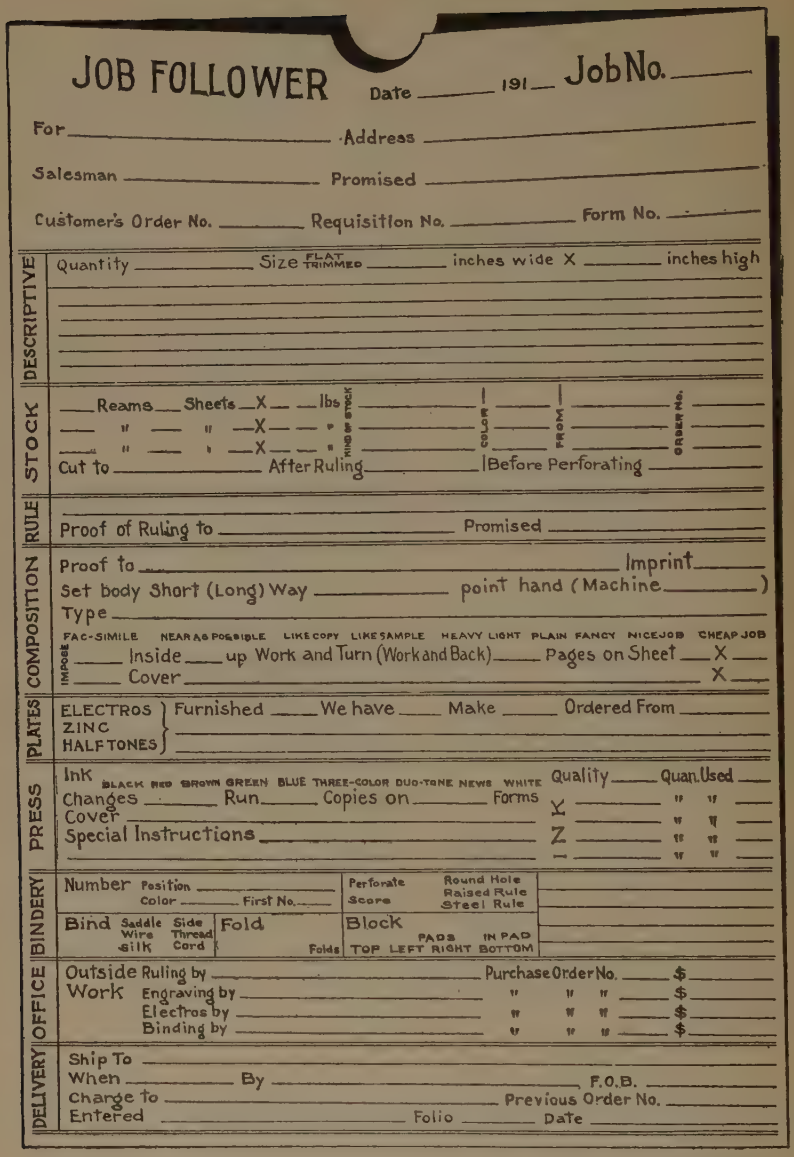
" _____ " _____ " _____

" _____ " _____ " _____

" _____ " _____ " _____

" _____ " STOCK ROOM DATE _____ 191__

FIG. 20. Standard Parts Order. (See §§ 31, 55, 311.) Suggested size, 4″x6″.



JOB FOLLOWER Date ____ 191__ Job No. ____

For ____ Address ____

Salesman ____ Promised ____

Customer's Order No. ____ Requisition No. ____ Form No. ____

DESCRIPTIVE

Quantity ____ Size FLAT TRIMMED ____ inches wide X ____ inches high

STOCK

____ Reams ____ Sheets ____ X ____ ____ lbs

____ " ____ " ____ X ____ " KIND OF STOCK ____ COLOR ____ FROM ____ ORDER No. ____

____ " ____ " ____ X ____ "

Cut to ____ After Ruling ____ Before Perforating ____

RULE

Proof of Ruling to ____ Promised ____

COMPOSITION

Proof to ____ Imprint ____

Set body Short (Long) Way ____ point hand (Machine ____)

Type ____

FAC-SIMILE NEAR AS POSSIBLE LIKE COPY LIKE SAMPLE HEAVY LIGHT PLAIN FANCY NICE JOB CHEAP JOB

IMPOSE ____ Inside ____ up Work and Turn (Work and Back) ____ Pages on Sheet ____ X ____

____ Cover ____ X ____

PLATES

ELECTROS, ZINC, HALF TONES } Furnished ____ We have ____ Make ____ Ordered From ____

PRESS

Ink BLACK RED BROWN GREEN BLUE THREE-COLOR DUO-TONE NEWS WHITE Quality ____ Quan. Used ____

Changes ____ Run ____ Copies on ____ Forms X ____ " " ____

Cover ____ Z ____ " " ____

Special Instructions ____ — ____ " " ____

BINDERY

Number ____ Position ____ Color ____ First No. ____

Perforate Round Hole Score Raised Rule Steel Rule

Bind Saddle Wire Side Thread Silk Cord

Fold ____ Folds

Block PADS IN PAD TOP LEFT RIGHT BOTTOM

OFFICE

Outside Work Ruling by ____ Purchase Order No. ____ $ ____

Engraving by ____ " " " ____ $ ____

Electros by ____ " " " ____ $ ____

Binding by ____ " " " ____ $ ____

DELIVERY

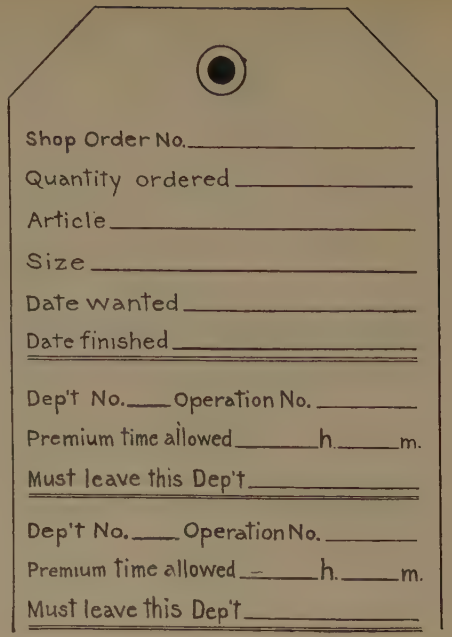
Ship To ____

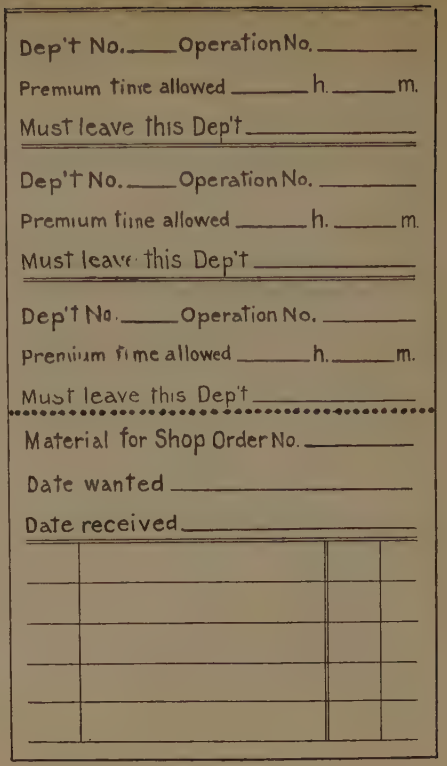
When ____ By ____ F.O.B. ____

Charge to ____ Previous Order No. ____

Entered ____ Folio ____ Date ____

FIG. 21. Printers' Job Follower. (See §§ 31, 211, 212, 270.) Suggested size, 7¾" x 11¾".




Dep't No. Operation No.
Premium time allowed h. m.
Must leave this Dep't
Dep't No. Operation No.
Premium time allowed h. m.
Must leave this Dep't
Dep't No. Operation No.
Premium time allowed h. m.
Must leave this Dep't
Material for Shop Order No.
Date wanted
Date received

FIGS. 22a (Left), 22b (Right). Premium Time Allowance Order. (See §§ 31-33.) Suggested size, 4"x13".

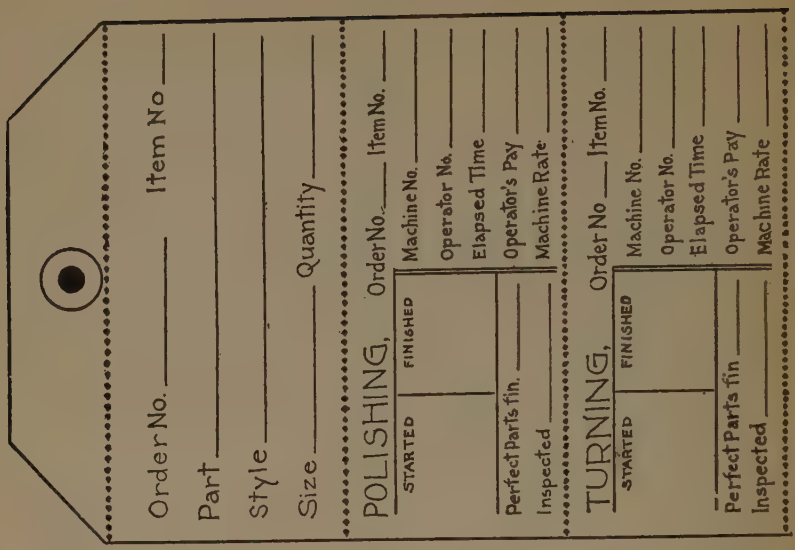


Fig. 23a. Standard Routine Machine Operation Order—Upper Part. (See §§ 31, 263, 311.) Size below.

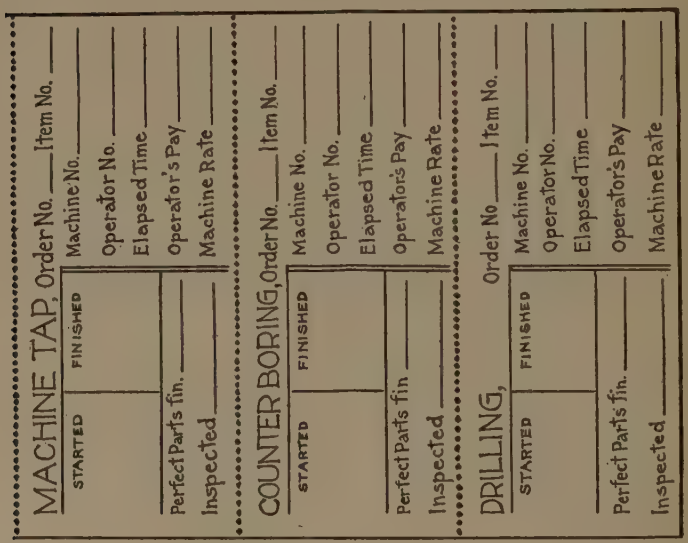


Fig. 23b. Standard Routine Machine Operation Order—Lower Part. Suggested size, complete form, 4"x11".

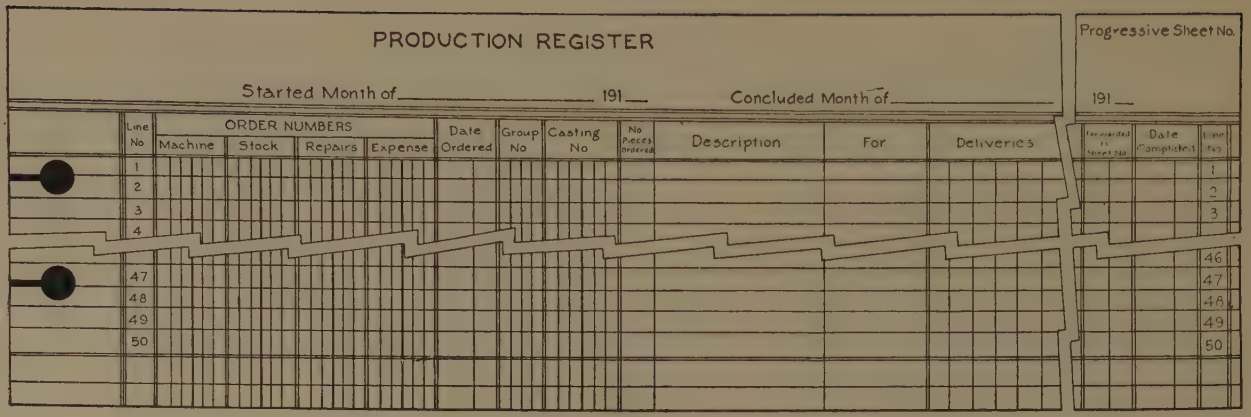
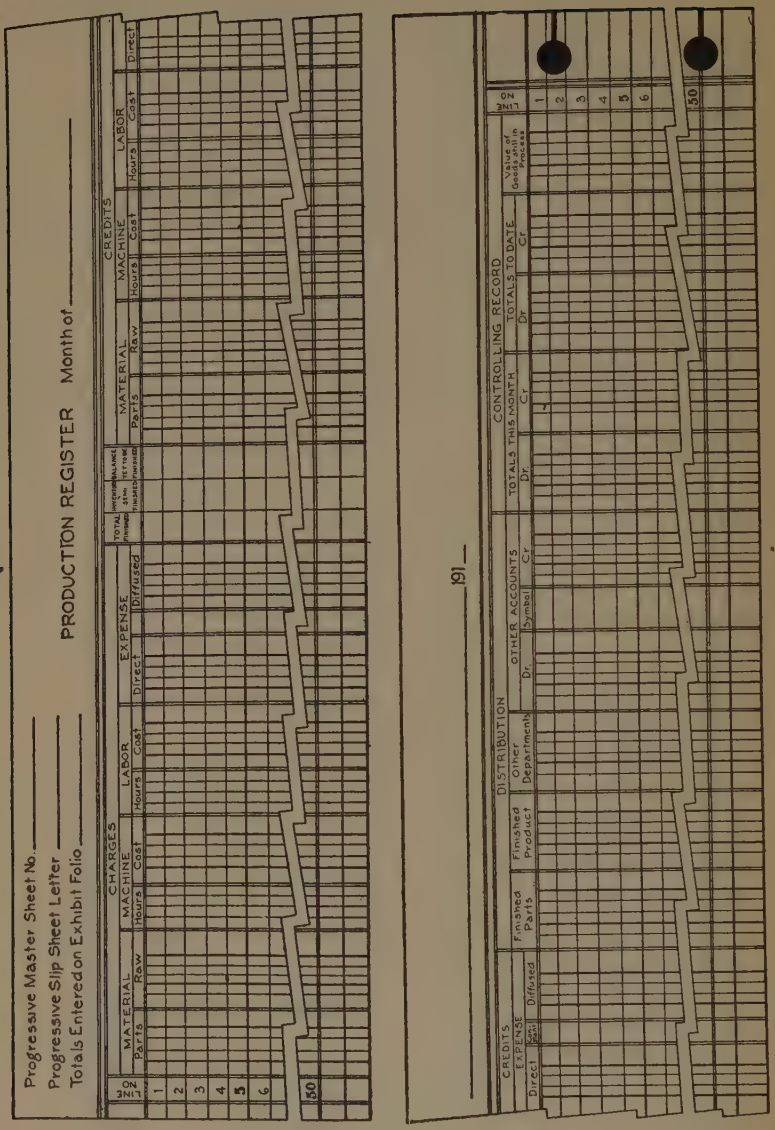


FIG. 24. Production Register. Master Sheet. (See §§ 271-276; also Ch. XXXV.) Suggested size, 16"x51 lines.



FIGS. 25 and 26. Production Register Detail Sheet—Left and Right Halves. (See §§ 271-276; also Ch. XXXV.) Suggested size, complete form, 26″x51 lines deep.

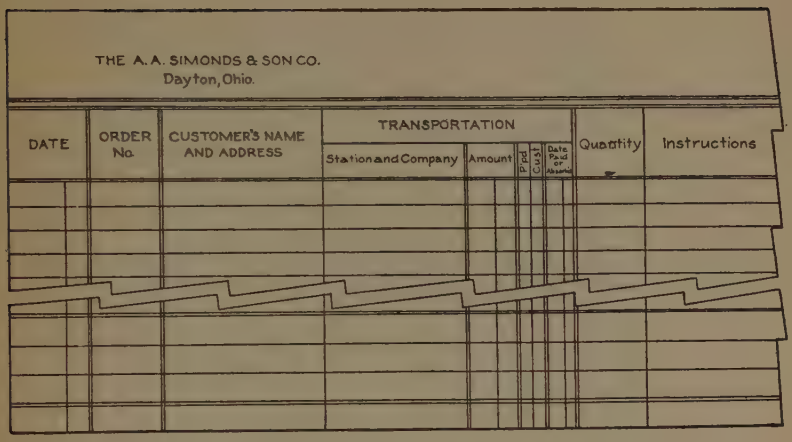


FIG. 27. Production Order Register—Left Half of Left-Hand Page. (See §§ 214, 304, 311; also Ch. XXXV.)

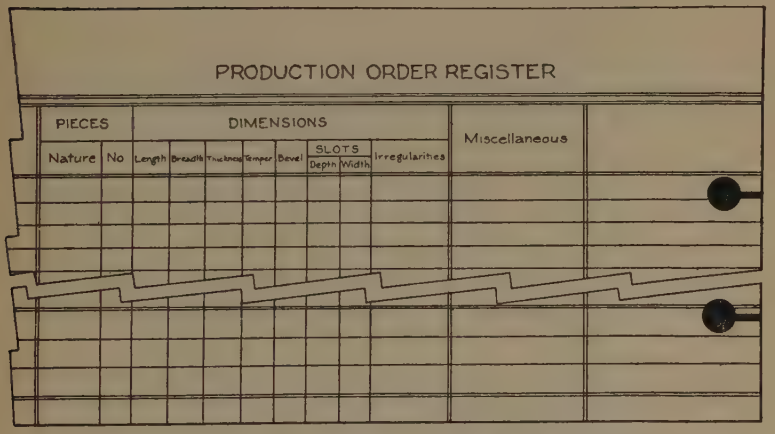


FIG. 28. Production Order Register—Right Half of Left-Hand Page. Suggested size, complete page, 20″x40 lines.

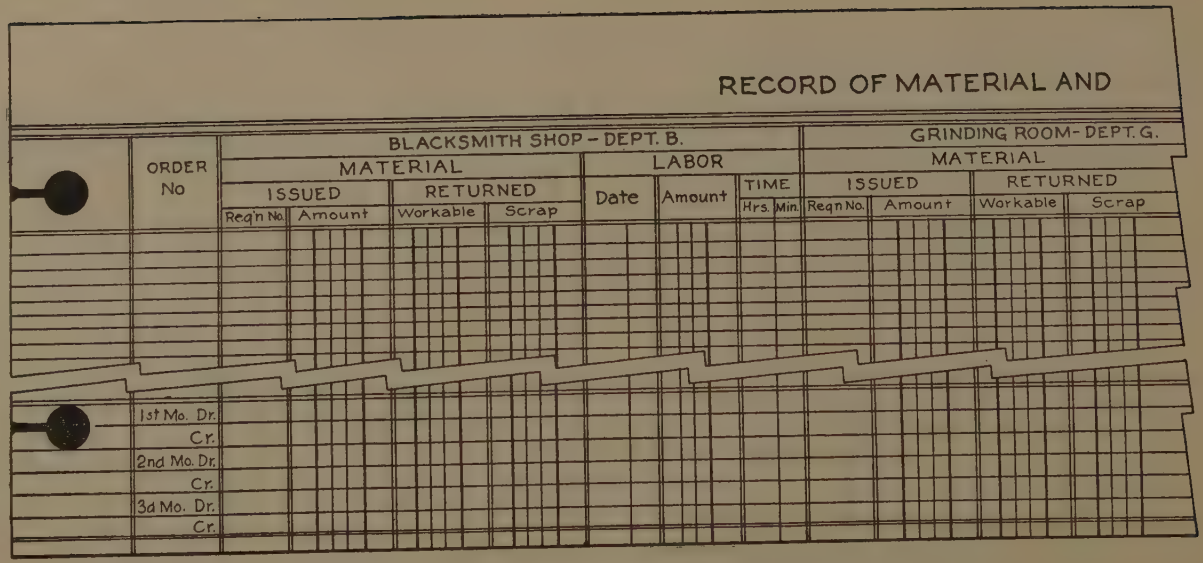


FIG. 29. Production Order Register—Left Half of Right-Hand Page.
(See §§ 214, 304, 311; also Ch. XXXV.) See Fig. 30 for size.

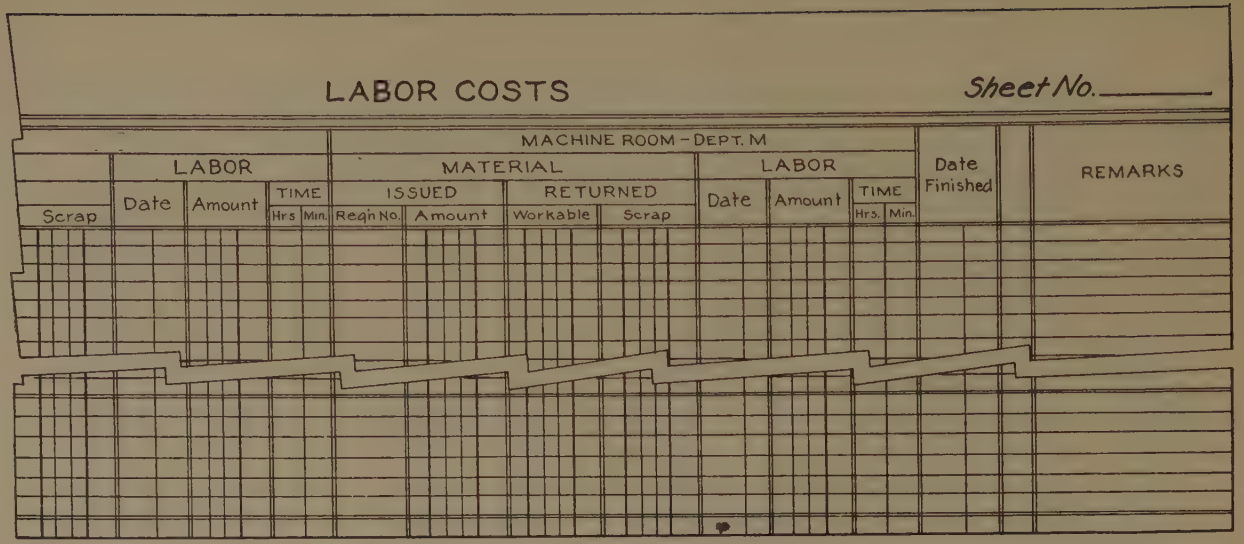


FIG. 30. Production Order Register—Right Half of Right-Hand Page. Suggested size, complete page, 20″ x 40 lines.

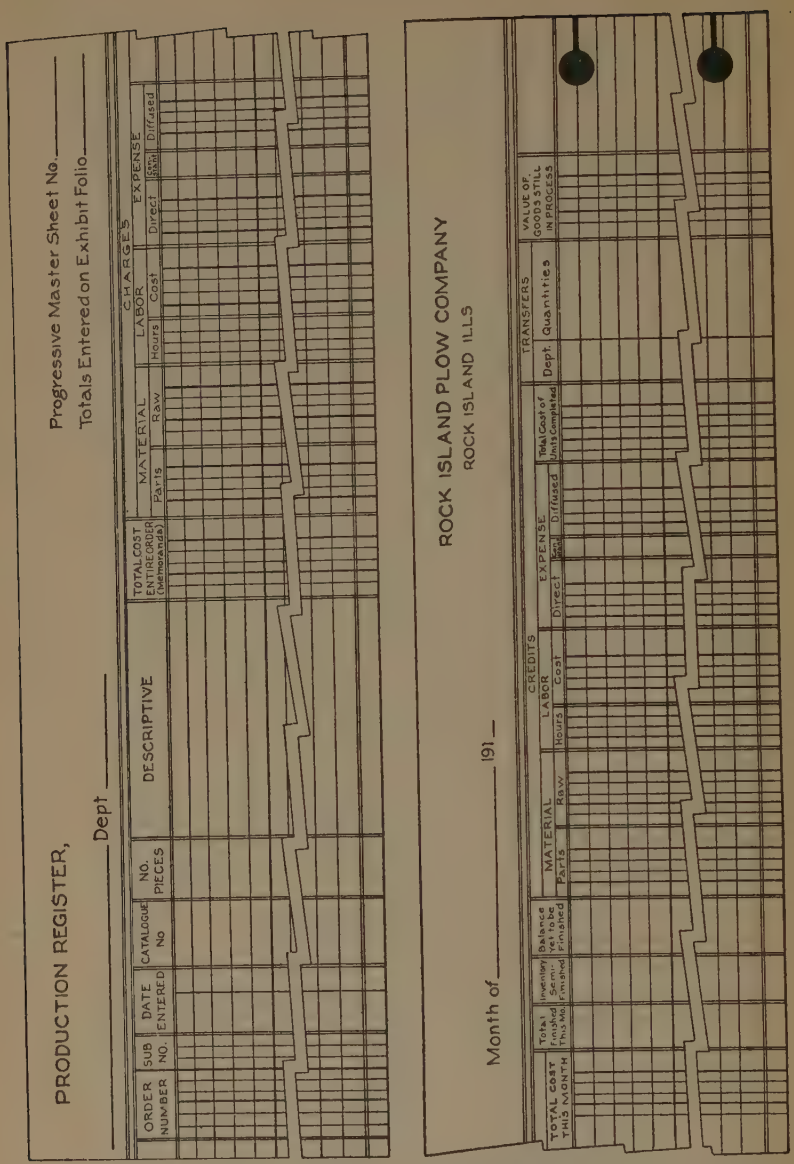


FIG. 31 (Upper) and 32 (Lower). Production Register—Left and Right Half of Page. (See § 304; also Ch. XXXV.) Suggested size, complete page, 26″x40 lines.

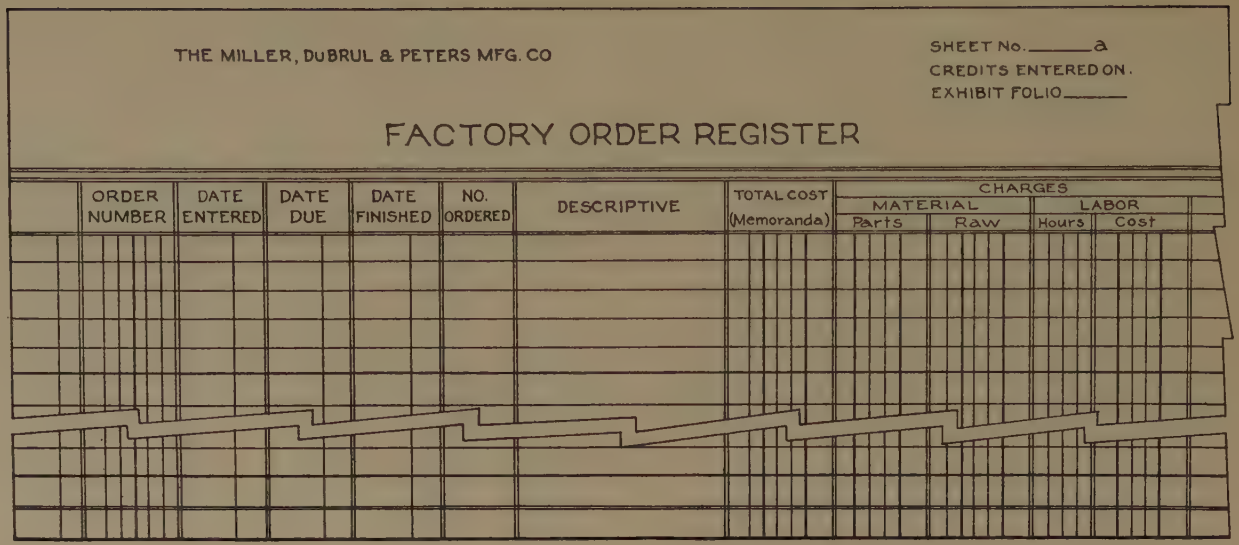


Fig. 33. Factory Order Register. Master Sheet—Left Half. (See §§ 304, 311.) See Fig. 34 for size.

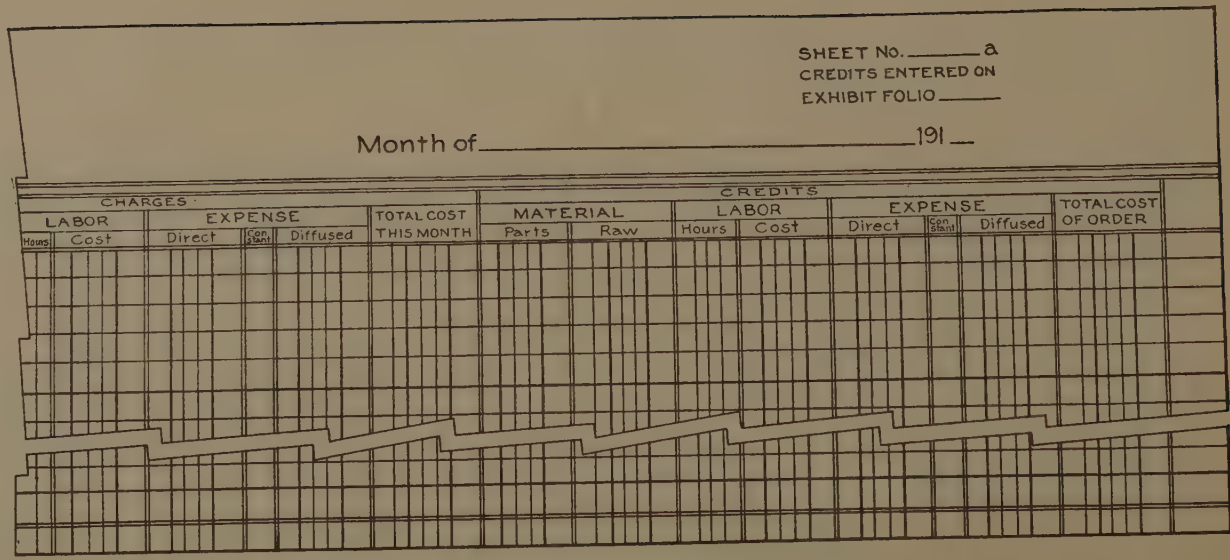


FIG. 34. Factory Order Register. Master Sheet—Right Half. Suggested size, complete form, 22″x41 lines.

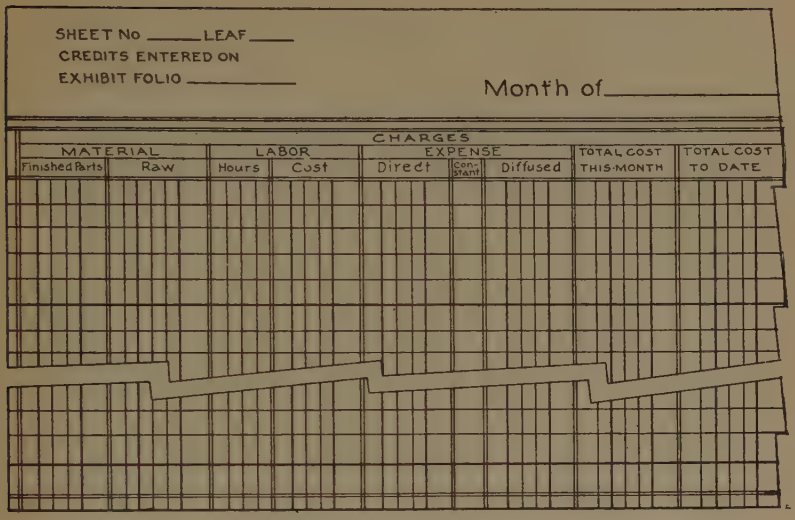


FIG. 35a. Factory Order Register, Slip Sheet—Left Half. (See §§ 304, 311).

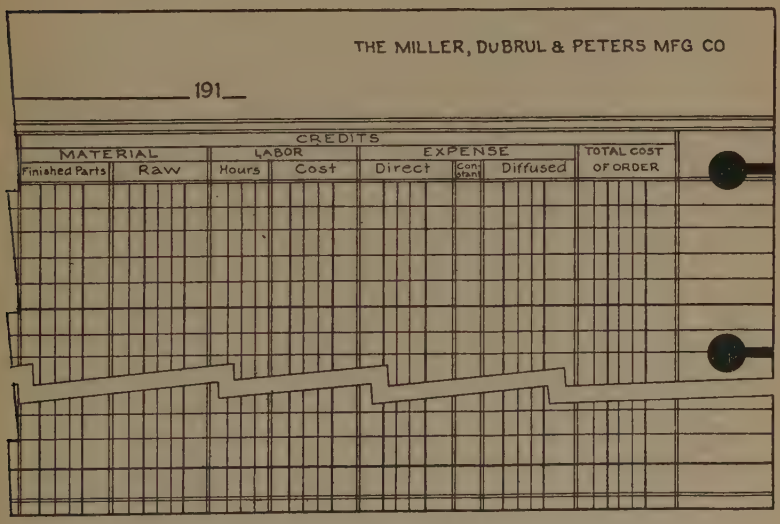
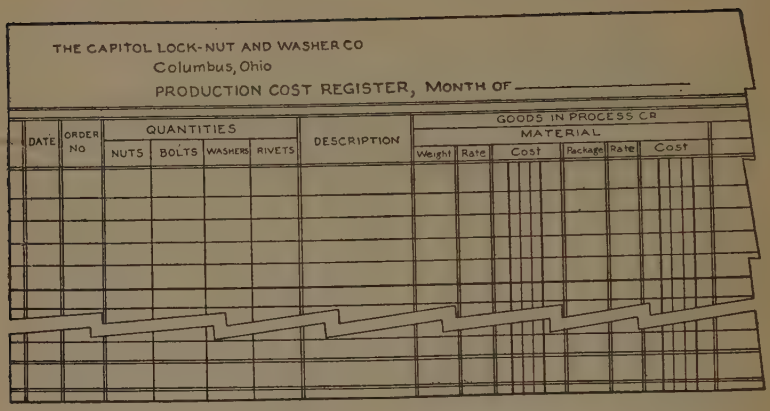
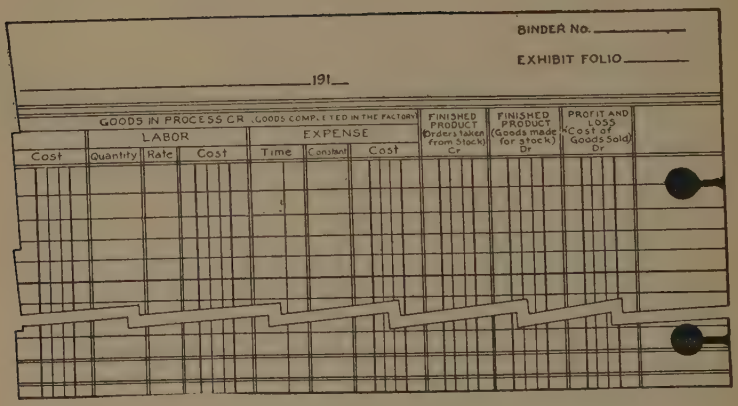


FIG. 35b. Factory Order Register, Slip Sheet—Right Half. Suggested size, complete form, 14″x41 lines.


THE CAPITOL LOCK-NUT AND WASHER CO
Columbus, Ohio
PRODUCTION COST REGISTER, MONTH OF _____

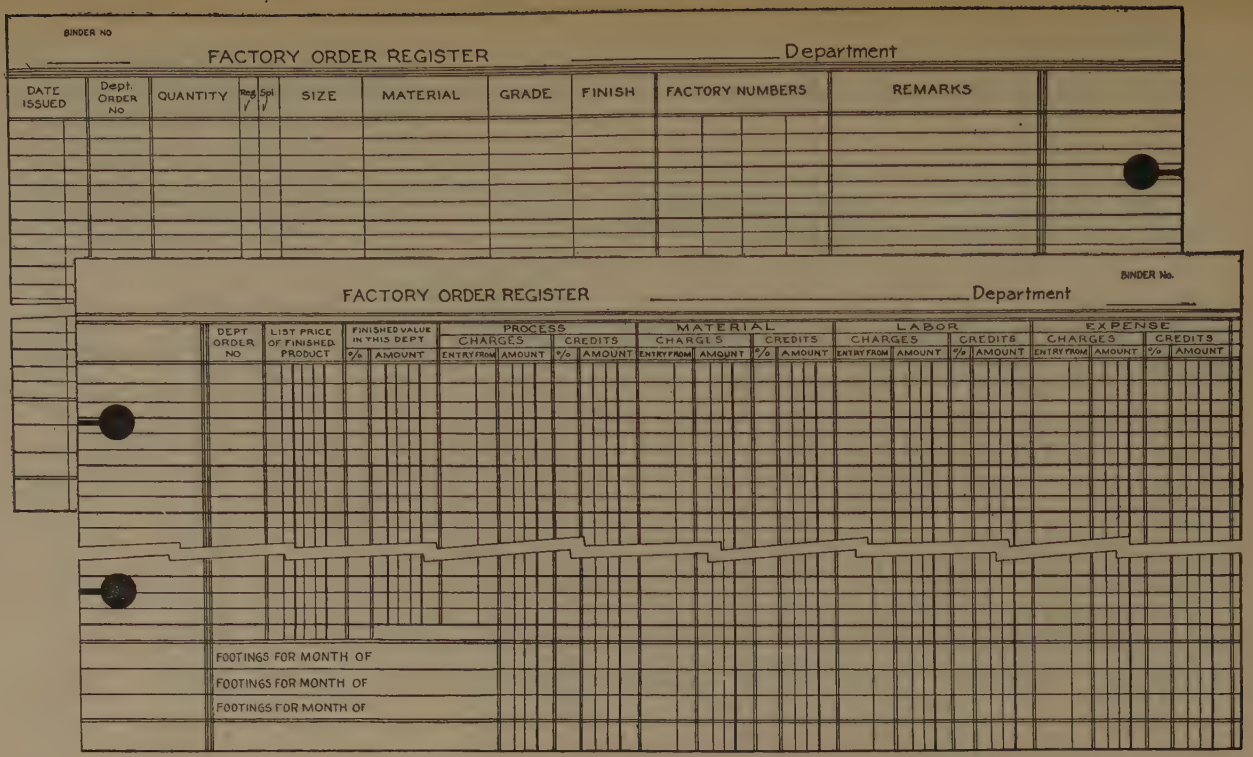
DATE	ORDER NO	QUANTITIES				DESCRIPTION	GOODS IN PROCESS CR					
		NUTS	BOLTS	WASHERS	RIVETS		MATERIAL					
							Weight	Rate	Cost	Package	Rate	Cost

Fig. 36. Production Cost Register—Left Half.
(See § 311; also Ch. XXXV.)


BINDER No. _____
EXHIBIT FOLIO _____
191__

GOODS IN PROCESS CR (GOODS COMPLETED IN THE FACTORY)							FINISHED PRODUCT (Orders taken from Stock) Cr	FINISHED PRODUCT (Goods made for stock) Dr	PROFIT AND LOSS (Cost of Goods Sold) Dr
	LABOR			EXPENSE					
Cost	Quantity	Rate	Cost	Time	Constant	Cost			

Fig. 37. Production Cost Register—Right Half.
Suggested size, complete form, 18″x41 lines.



FIGS. 38 (Upper) 39 (Lower). Factory Order Register—Face and Reverse of Page. (See §§ 214, 231, 233.) Suggested size, 15"x36 lines.

CHAPTER XXXVIII.

FORMS RELATING TO MATERIAL.

§ 313. Comment on Forms of Chapter.*

The forms of the present chapter are those relating directly to material. Other forms having to do more or less directly with material will be found under Figures 15 to 19, and 120. Purchase analysis forms are treated in a general way in § 51, material requisition forms in §§ 52, 55 and 56, and inventory forms in §§ 156, 199 and 235.

Figures 63 to 65. Purchase Analysis. Printing. If spread over one folio in the usual way, the number of columns employed in this form of Purchase Analysis would make a book of inconvenient size. To avoid this the long and short leaf plan of book construction is usually employed; Figure 63 being the master sheet, while Figures 64 and 65 are respectively the obverse and reverse of the slip sheet. One slip sheet (rulings on both sides) goes with each master sheet (rulings on one side only) and the line numbers on the master sheet indicate the corresponding line number on the co-ordinated slip sheet.

Figures 71 and 72. Stores Withdrawal Reports. A form similar to that shown in Figure 84 is usually employed in conjunction with, and as a summarizing medium for, forms such as those shown in Figures 71 and 72.

Figure 74. Bill of Material. For a definite quantity of product, the quantity of material or number of integrants necessary is determined by an analysis of one unit of the

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 314.

product and also by other presumably good and sufficient tests. The form is used to pass credit to the Stores Account or to preceding departments for goods presumably used (§ 199) and also for charging "Waste Stores" with waste actually made and set aside for future disposal (§ 53).

Figure 75. Bill of Material and Finished Parts—for specific quantities. Where this form is used it frequently happens that "parts" have to be made to fill requirements, and a form similar to that of Figure 10 will be used in conjunction with Figure 75, as described in the latter portion of § 56.

Figure 84. Summary of Material Issuances. Used mainly in conjunction with forms such as those of Figures 71 and 72. The tops of columns are left blank for writing in the names or designations of commodities. The columns are also separated into groups with space for indicating the store number from whence goods were withdrawn, in order that each stores account can be given its proper credit for goods parted with. The "Substitution" column is for recording the excess cost involved where goods of a higher price have been issued in lieu of those specified but not in stock. A line across the entire sheet is devoted to each entry, the columns being arranged for the segregation of items in each separate withdrawal report.

Figures 87 and 88. Semi-finished Work in Process (left and right). A form of this character can be filled out in the office (becoming what is known as a "paper inventory") when used in conjunction with forms similar to Figures 97, 183 to 185. This is frequently done in interim periods between regular physical inventory times. (See Figure 95.)

§ 314. Forms Used in Connection with Material.

STOCK DEP'T
ROCK ISLAND PLOW CO.

DATE _____ 19 ___

TO PURCHASING DEPT.:—
PLEASE ORDER THE FOLLOWING NAMED GOODS

TO BE DELIVERED _____ FOR MACHINE _____

_____ STOCK CLERK

QUANTITY	SIZE	√	DESCRIPTIVE

Fig. 40. Request for Purchases. (See § 37.) Suggested size, 6¼"x6½".

NEED . . . Buy for our need, our want may wait.

Time _____ No. _____

Date _____ 190 Ord. No. _____

Think of this need with care. To foresee a need is good. Haste maketh waste.

We need for: _____

Goods as follows: _____

_____

_____

_____

_____

How soon needed? _____

_____

Oh! Wise Judge
your name upon this
spot

I, _____
think we need.

Hear ye! Oh! Wise Judge _____

Has the vendor before this been at fault? _____

How much of the goods named do we use? _____

What knowledge does the buyer lack, as to kind, cost, etc.? _____

Write wisely of all things, that the Buyer may be shrewd and watchful _____

I, _____
have judged as wisely as I may.

FIG. 41. Request for Purchases. Reproduction of form used by a prominent manufacturing concern.

THE KILBOURNE & JACOBS MFG. CO.

From OFFICE COPY 2 | COLUMBUS, O. 191__

ORDER No. 1248
TERMS
F.O.B.
SHIP VIA

For delivery at latest _____ the goods listed below
Packages to be marked to our _____ No. _____

ACKNOWLEDGEMENT	PROMISED	INVOICE DATE	DATE APPROVED

QUANTITIES	DESCRIPTIVE

THE KILBOURNE & JACOBS MFG. CO.

To | COLUMBUS, O 191__

ORDER No 1249
TERMS
F.O.B
SHIP VIA

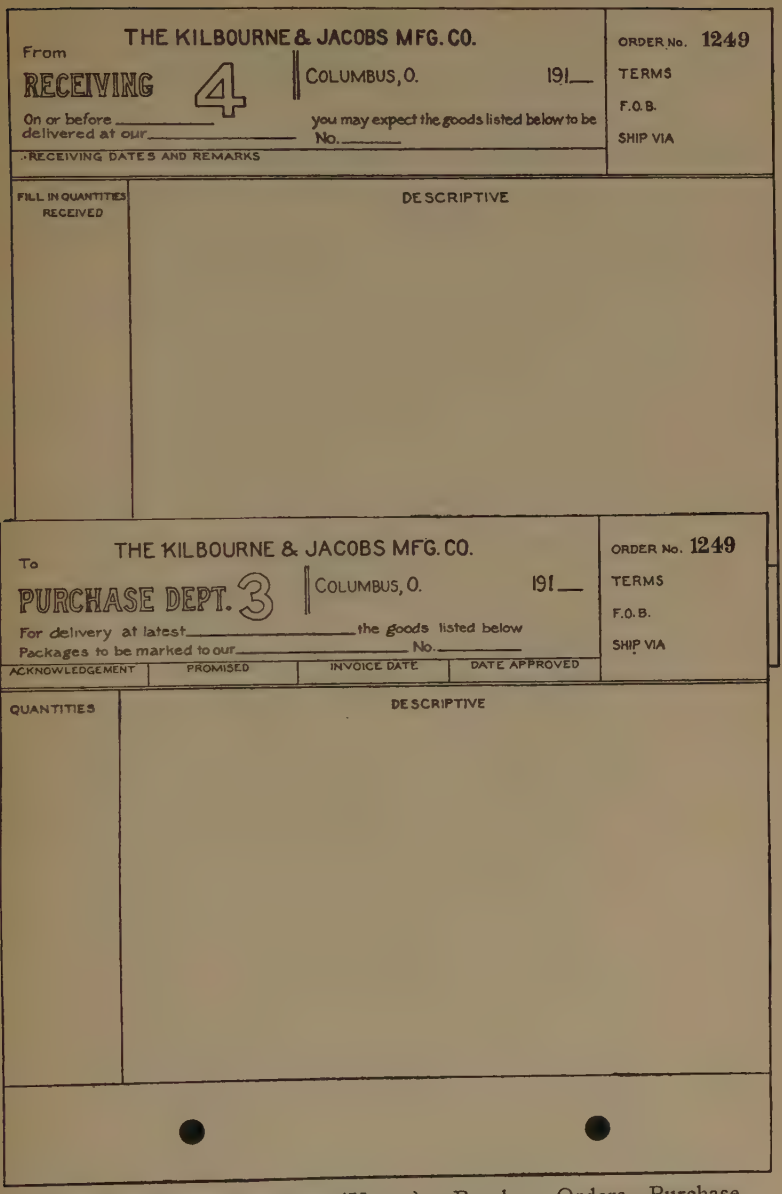
Deliver not later than _____ the goods listed below
Mark Packages to us at our _____ No. _____
Kindly ACKNOWLEDGE RECEIPT of this order, and if you cannot make immediate shipment, advise us when you can ship
SHOW OUR ORDER NUMBER ON YOUR INVOICE.

QUANTITIES	DESCRIPTIVE

THE KILBOURNE & JACOBS MFG. CO.

_____
PURCHASING AGENT

FIGS. 42 (Lower), 43 (Upper). Purchase Order. Office File Copy and Supply House Copy. (See §§ 38, 40, 41.) Suggested size, 8″x7″.



FIGS. 44 (Lower) and 45 (Upper). Purchase Orders—Purchase Department and Receiving Clerk Copies. (See §§ 38, 40, 41.) Suggested size, 8"x7".

THE GLOBE WERNICKE CO.
CINCINNATI

RECORD OF GOODS ORDERED.

Date	Order No.	Ordered From	Lumber	Hardware	Metal	Paint	M'f'g Expense	Sundry	Total This Day	Total This Month	Date Received	Remarks

FIG. 46. Material Ordered Register. (See § 37.) Suggested size, 13″x30 lines.

DEERING HARVESTER CO
CHICAGO

RECORD OF CARS RECEIVED

Date Received	From	Rail Road Weight	Our Weight	Our Order No	F.O.B.		Remarks re goods	Transportation Record						Payment	
								Railroad	Car No	Transfer from Car No	Pro. No.	Amount Freight		Date	Ck. No

FIG. 47. Carload Receiving Book. (See §§ 42, 149.) Suggested size, 13"x30 lines.

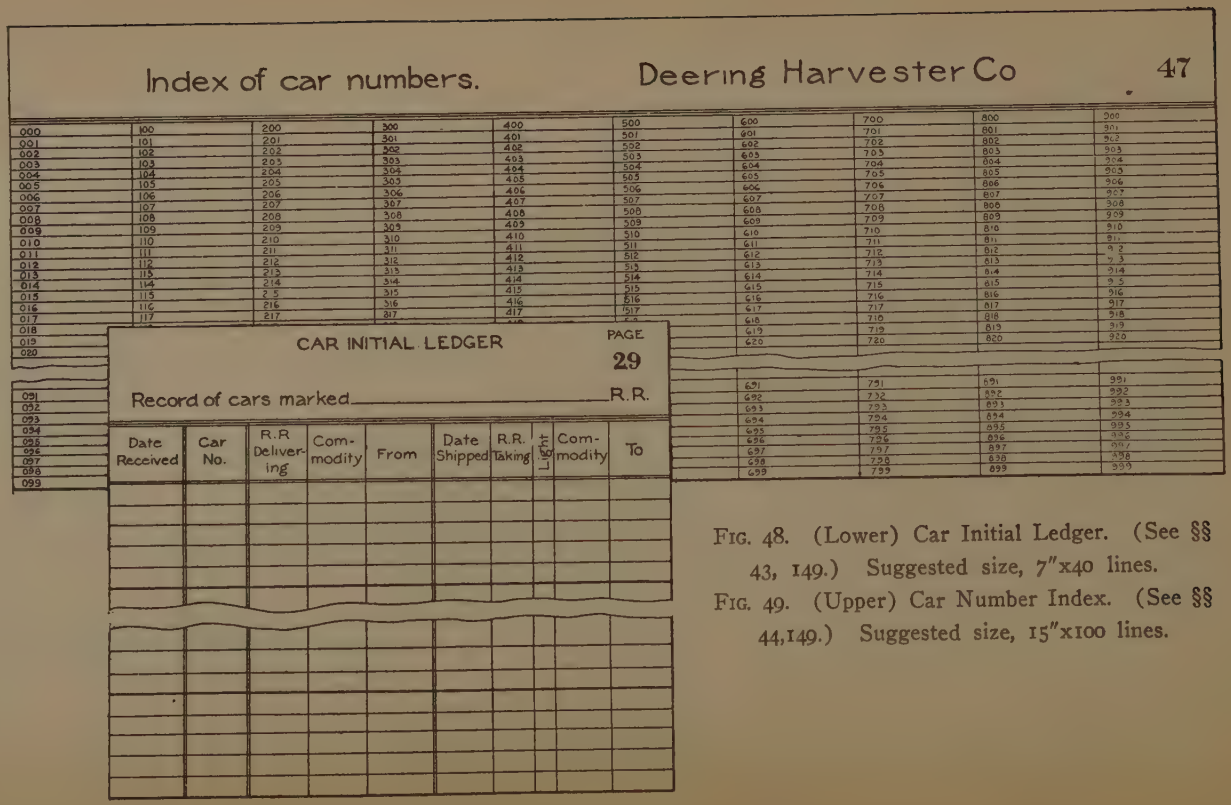


FIG. 48. (Lower) Car Initial Ledger. (See §§ 43, 149.) Suggested size, 7"x40 lines.

FIG. 49. (Upper) Car Number Index. (See §§ 44,149.) Suggested size, 15"x100 lines.

CHICAGO RAILWAY EQUIPMENT CO., JERSEY CITY

CASTING RECORD, PATTERN NO._____

Ordered		Foundry Record			Annealing Record				Deliveries		Total Due
Date	Quantity	Date	Cast	Balance	Date	To Oven	From Oven	Still in Oven	Date	Quan	

THE MARION STEAM SHOVEL CO. For_____ Pcs. per Machine_____ Commodity_____

Dates verified_____ Unit_____ Size_____ Weight_____ Group_____ Store_____ Location_____

RECEIVED					ISSUED					ISSUED					BALANCES			
Date	From	Quan	Price	Value	Date	Req'n	Quan	Price	Value	Date	Req'n	Quan	Price	Value	Date	Quan	Price	Value

ORDERED				
Date	Ord No	Needed	Ordered	√

FIG. 50 (Lower). Stock Ledger. (See §§ 27, 28, 39, 45-48.) Suggested size, 10"x30 lines.

FIG. 51 (Upper). Malleable Castings Record. (See § 40.) Suggested size, 8"x25 lines.

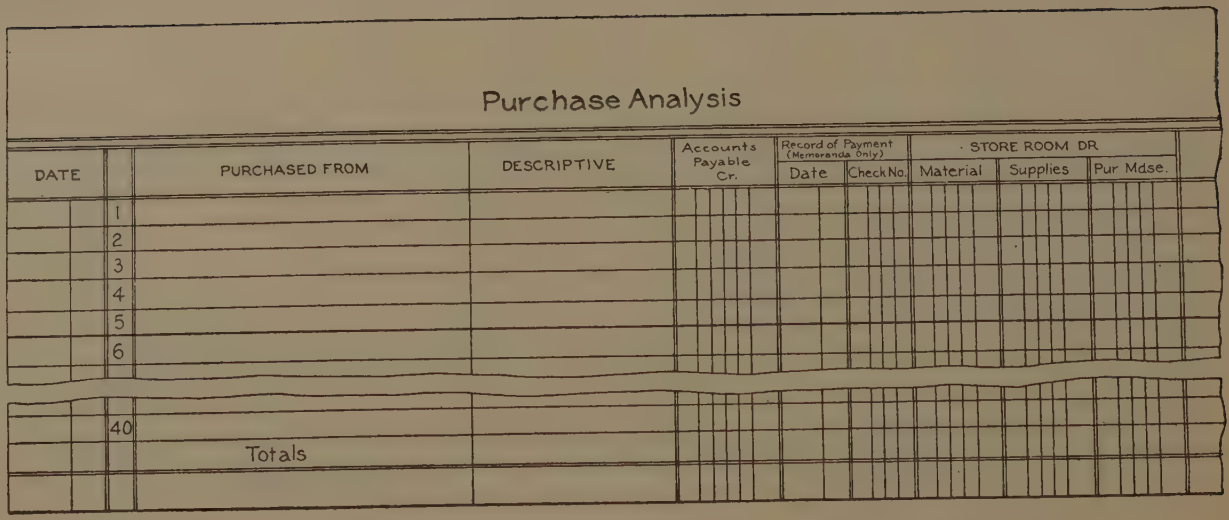


FIG. 52. Purchase Analysis for Machine Builders—Left Half. (See § 51.) For size see Fig. 53.

The Miller, DuBrul and Peters Mfg. Co.

ACCRUING MANFG COSTS			GOODS IN PROCESS DR.				COMMERCIAL COSTS DR.				Items in Suspense Dr.	OTHER ACCOUNTS BY NAME			
Account	✓	Dr.	Material	Account	✓	Direct Expense	New York Office	Account	✓	General		Dr.	Account	✓	Cr.

Fig. 53. Purchase Analysis for Machine Builders—Right Half. Suggested size, complete form, 23"x41 lines.

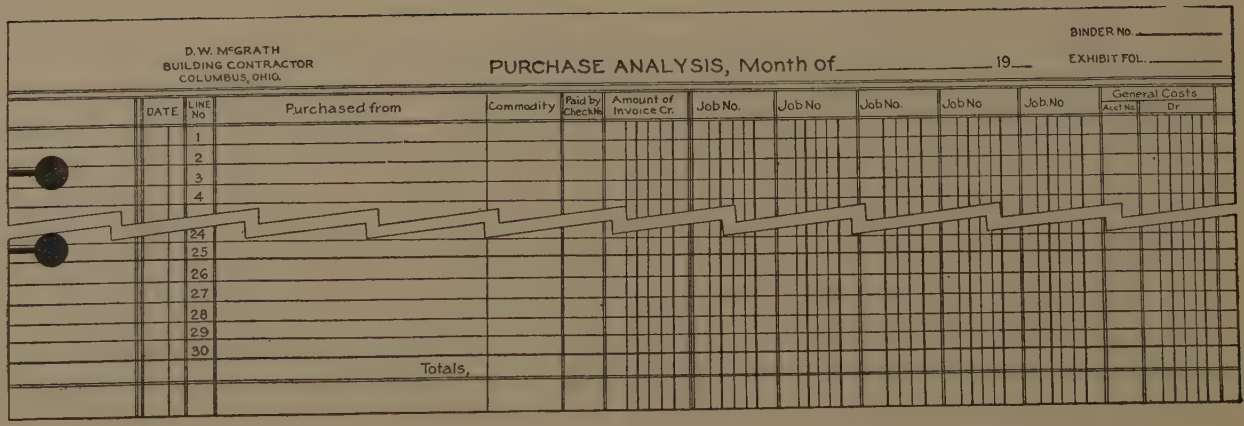
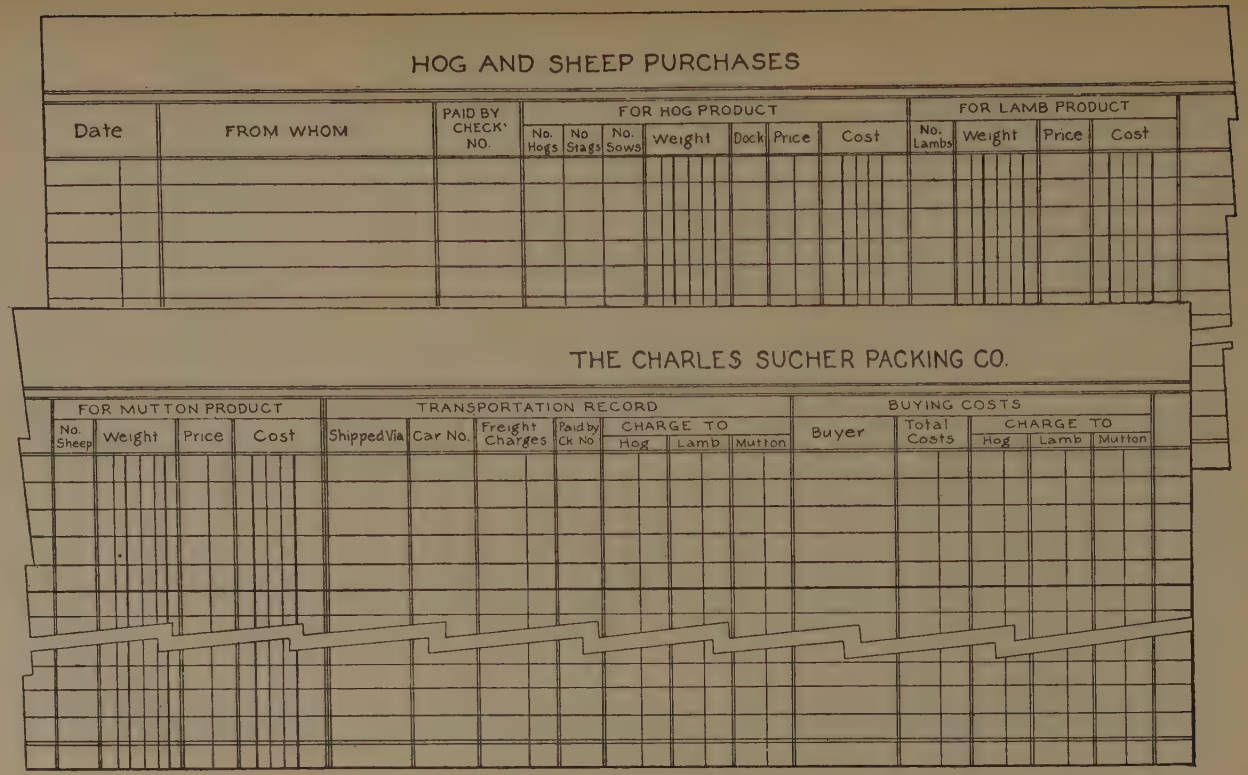
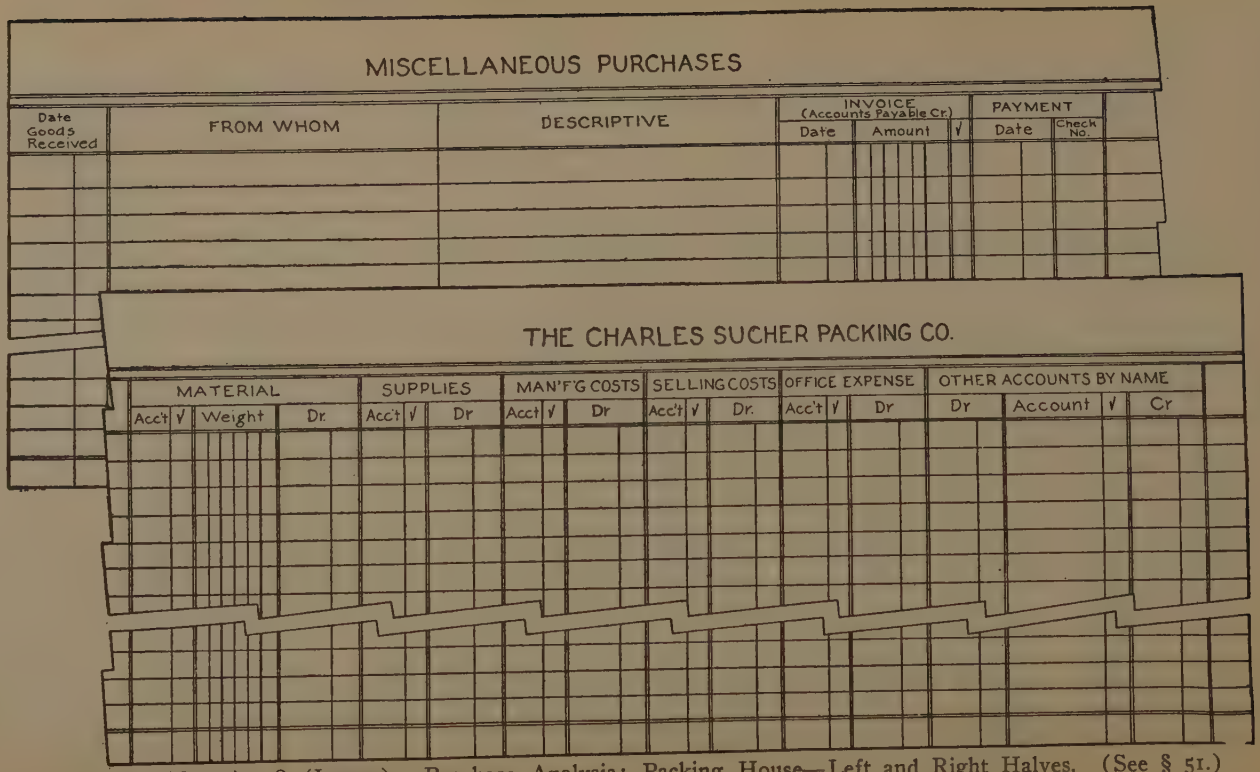


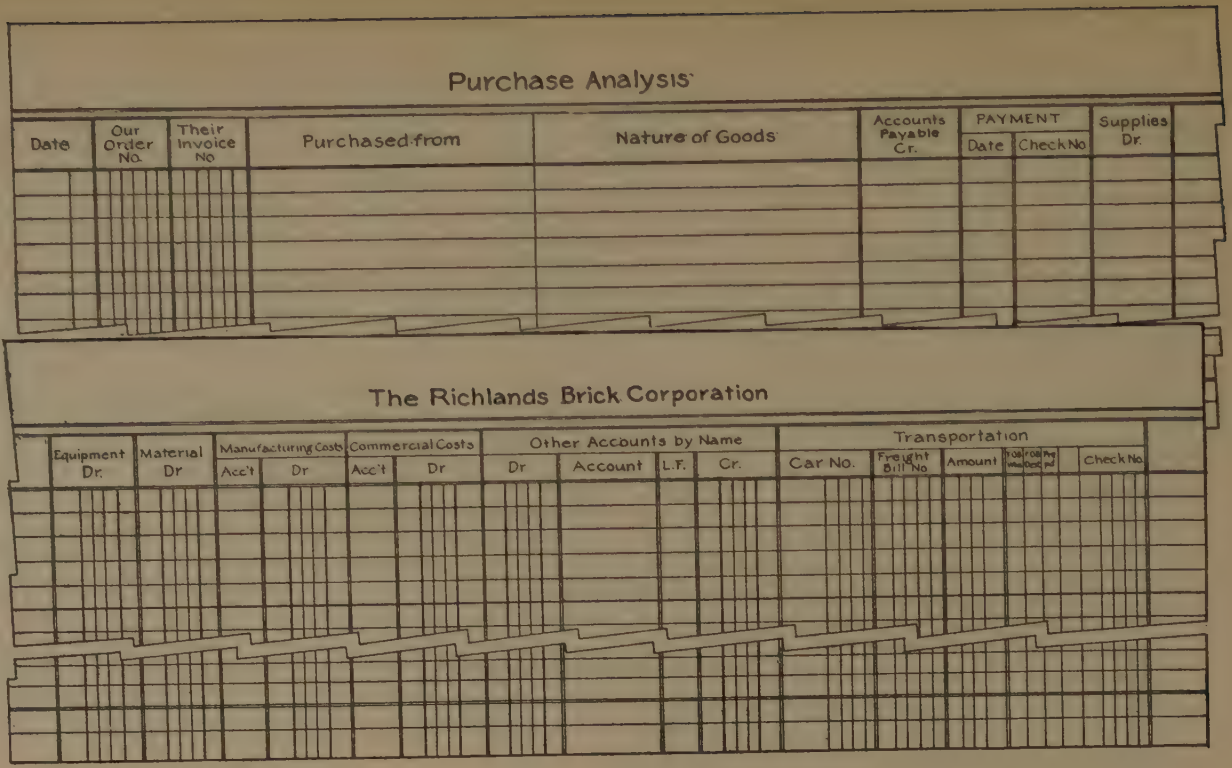
Fig. 54. Purchase Analysis for Contractors. (See § 51.) Suggested size, 15″x31 lines.



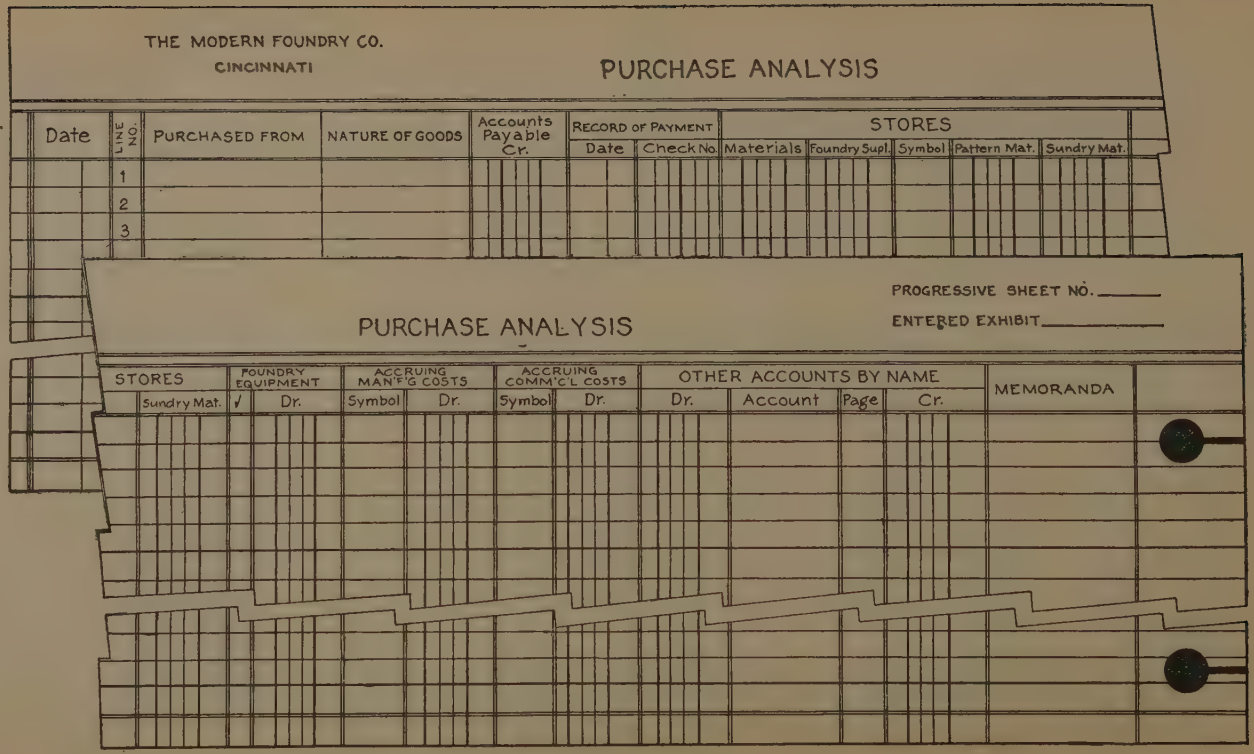
FIGS. 55 (Upper) 56 (Lower). Purchase Analysis. Live Stock. (See §51.) Suggested size, complete form, 22"x41 lines.



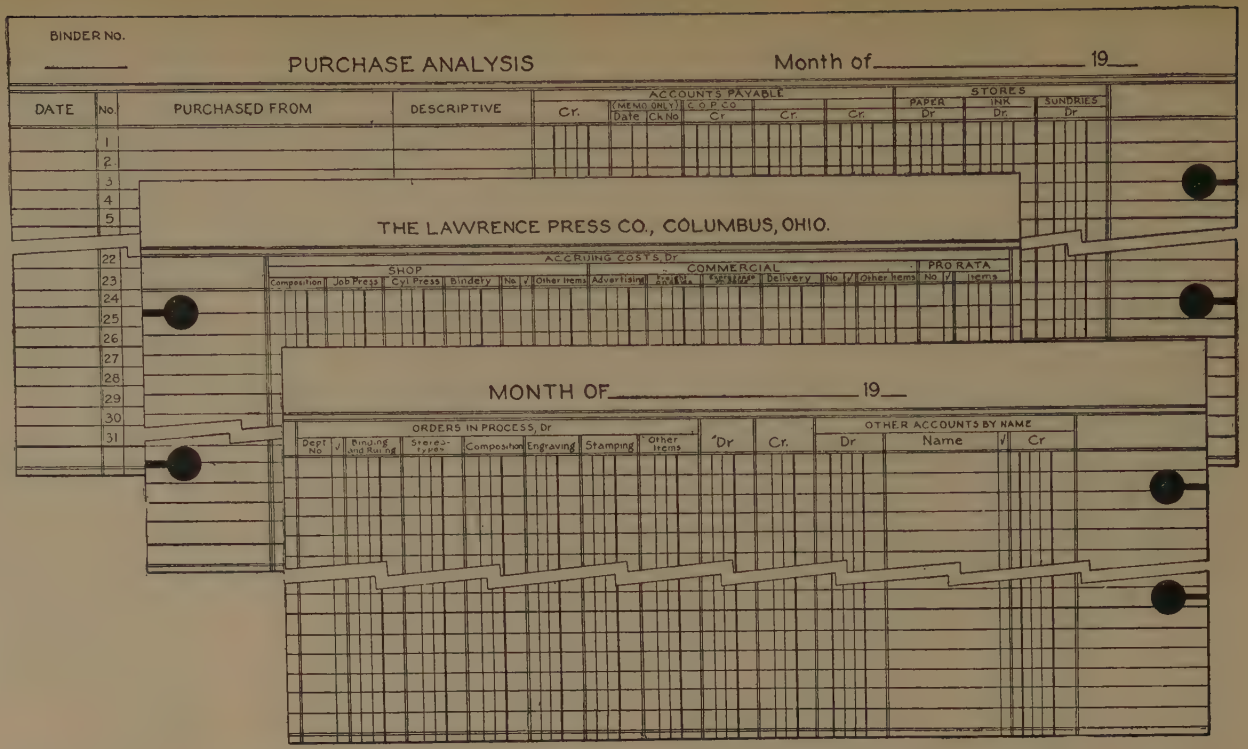
FIGS. 57 (Upper), 58 (Lower). Purchase Analysis: Packing House—Left and Right Halves. (See § 51.)
Suggested size, complete form, 22″x41 lines.



FIGS. 59 (Upper), 60 (Lower). Purchase Analysis. Brick Works. (See § 51.) Suggested size, 22"x41 lines.



FIGS. 61 (Upper), 62 (Lower). Purchase Analysis. Foundry. (See § 51.) Suggested size, complete form, 22"x41 lines.



FIGS. 63 (Top), 64 (Middle), 65 (Bottom). Purchase Analysis: Printer's Master Sheet and Slip Sheet. (See § 51, 313.) Suggested size, master sheet, 15″x31 lines; slip sheet 10½″x31 lines.

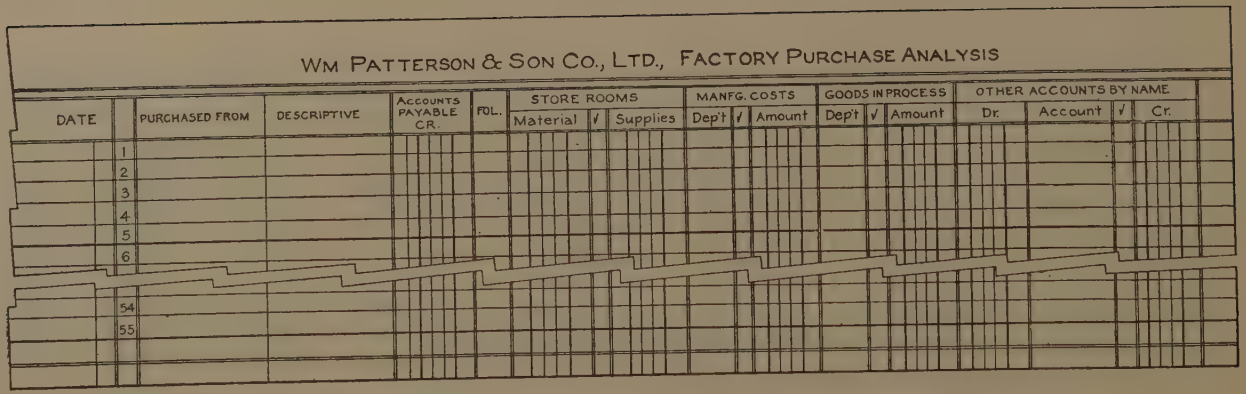
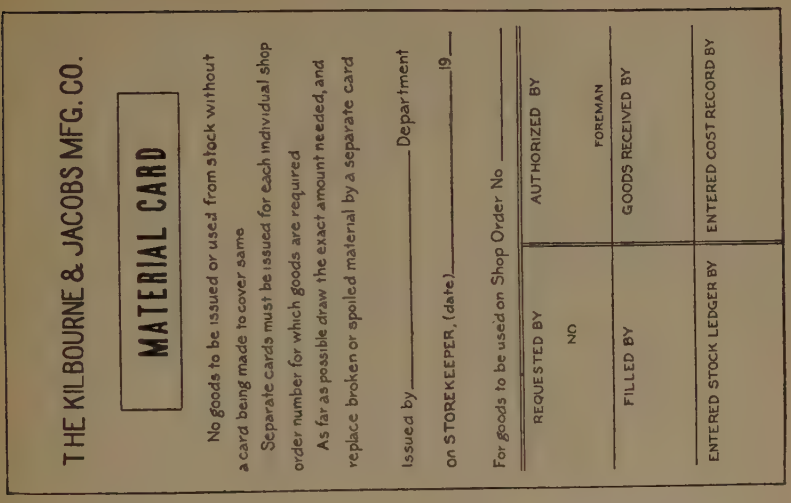


FIG. 66. Purchase Analysis for Confectioners. (See § 51.) Suggested size, 16″x56 lines.


THE KILBOURNE & JACOBS MFG. CO.

MATERIAL CARD

No goods to be issued or used from stock without a card being made to cover same

Separate cards must be issued for each individual shop order number for which goods are required

As far as possible draw the exact amount needed, and replace broken or spoiled material by a separate card

Issued by _____ Department

on STOREKEEPER, (date) _____ 19__

For goods to be used on Shop Order No _____

REQUESTED BY

NO

AUTHORIZED BY

FOREMAN

FILLED BY

GOODS RECEIVED BY

ENTERED STOCK LEDGER BY

ENTERED COST RECORD BY

Fig. 67. Material Requisitions Card—Front. (See §§ 55, 56.) See size below.

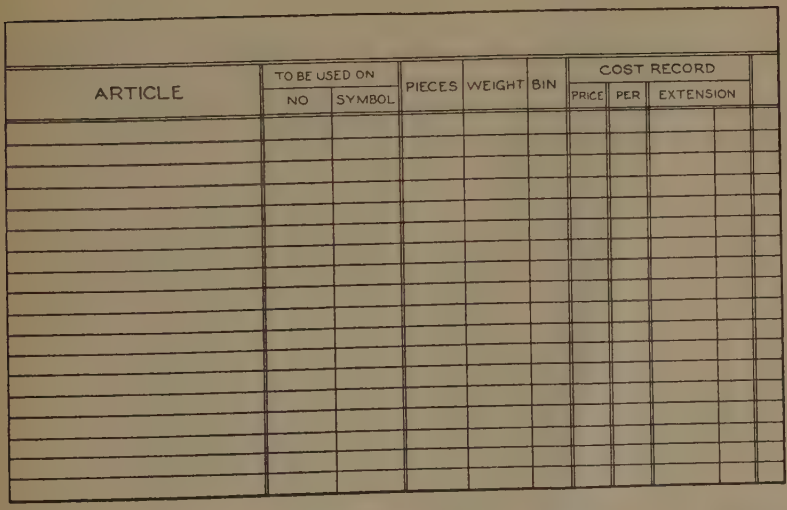
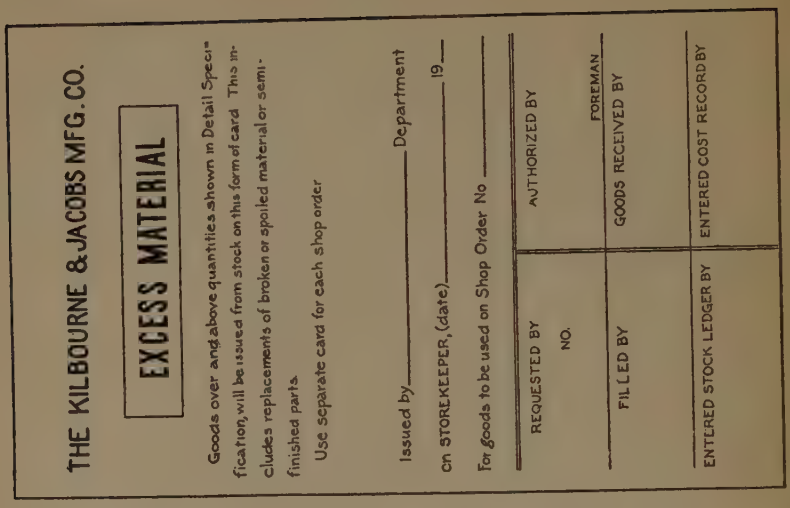

ARTICLE	TO BE USED ON		PIECES	WEIGHT	BIN	COST RECORD			
	NO	SYMBOL				PRICE	PER	EXTENSION	

Fig. 68. Material Requisitions Card—Back. Suggested size, 4"x6½".



THE KILBOURNE & JACOBS MFG. CO.

EXCESS MATERIAL

Goods over and above quantities shown in Detail Specification, will be issued from stock on this form of card. This includes replacements of broken or spoiled material or semi-finished parts.

Use separate card for each shop order

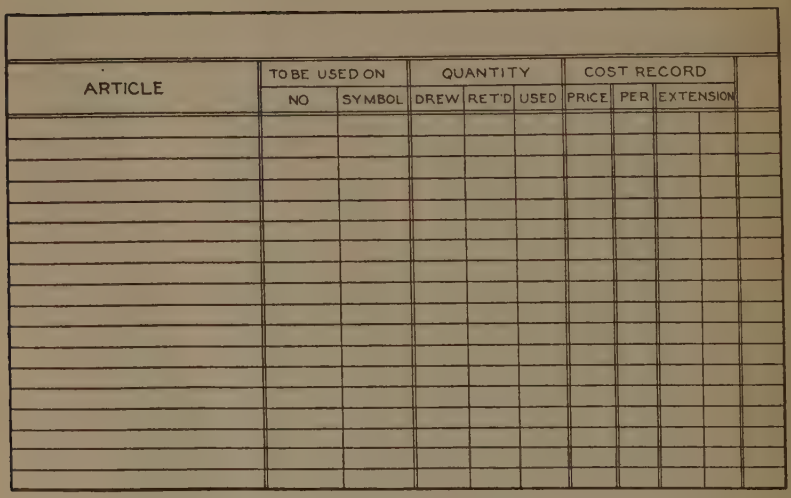
Issued by _____ Department

on STOREKEEPER, (date) _____ 19__

For goods to be used on Shop Order No _____

REQUESTED BY NO.	AUTHORIZED BY FOREMAN
FILLED BY	GOODS RECEIVED BY
ENTERED STOCK LEDGER BY	ENTERED COST RECORD BY

FIG. 69. Requisition for Excess Material—Front. (See §§ 55, 56, 153.) See size below.



ARTICLE	TO BE USED ON		QUANTITY			COST RECORD			
	NO	SYMBOL	DREW	RET'D	USED	PRICE	PER	EXTENSION	

FIG. 70. Requisition for Excess Material—Back. Suggested size, 4"x6½".

No 997 DEP'T D DIV. ____

SHUTTLEWORTH BROS. CO.

AMSTERDAM, N.Y.

Date _____

Cost Department:-
The following named goods have been withdrawn from the Stores indicated, for use in the division of the WINDING DEPARTMENT shown above.

_____ FOREMAN

WEIGHT	DESCRIPTION	No. BALES	LOT No.	STORE No.	RESERVE THIS FOR OFFICE USE
	Worsted Yarn 12/2/2				
	" " 13/2/3				
	" " 16/2				
	" " 16/2/3				
	Cotton, White 8/3				
	" Dyed 8/4				
	Linen, White 5½ lea				
	" Dyed 5½ lea				
	Jute, 2ply				
	Broken Skeins				
	Spoolers Waste				
	Bitwinders Waste				
	Linen Waste				
	Sweepings				

BALE NUMBERS, WEIGHTS, ETC. CAN BE SHOWN ON REVERSE HEREOF

FIG. 71. Stores Withdrawal Report. Yarn. (See §§ 56, 313.) Suggested size, 7"x11".

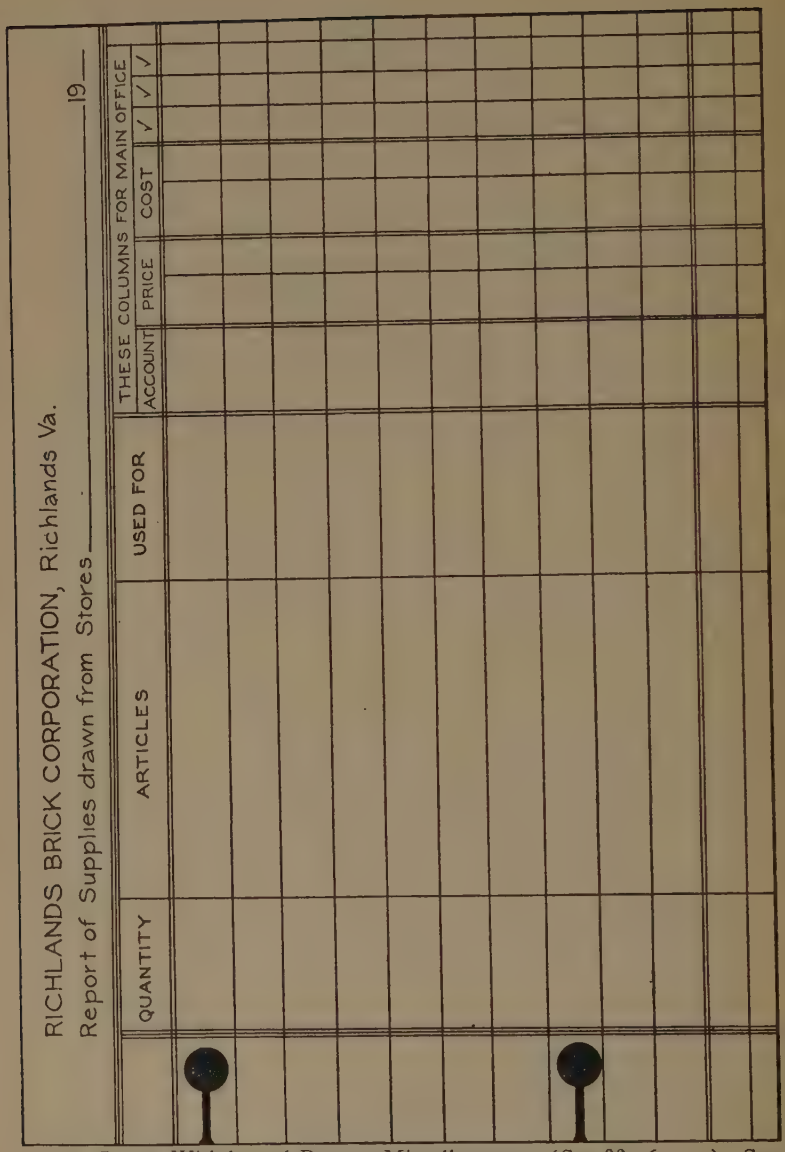


Fig. 72. Stores Withdrawal Report. Miscellaneous. (See §§ 56, 313.) Suggested size, 8¼"x5½".

THE GLOBE-WERNICKE CO.

FACTORY ACCOUNTANT:— Carthage Ave. Works,_____ 19__

The following indicated items of Hardware have this day been furnished by Department_____ for use with shipments of Bookcases in the white, K.D.

NO.	NAME OF ARTICLE	No To UNIT	DESCRIPTION	COPPER FINISH	BRASS FINISH	NO FINISH		LIST	EXTENSION
100	Nails for front hole End Irons	2	5/8 No. 16 Escutcheon Pins						
101	" second and fourth hole End Irons	4	1¼ No 13 " "						
102	" third hole End Irons	2	2¼ No. 13 " "						
103	" top center, lower front & rear shelves	12	5d coated Nails						
104	" Combination Shelf	4	2-in. No. 18 Finishing Nail						
105	" front hole Comb. Caps	2	5/8 No. 16 Escutcheon						
106	" back " "	2	1-In No. 13 "						
107	" ends of backs	10	7/8 Barrel Nails, Coated						
108	" lower edge of backs	5	3d coated "						
109	" rear of bottoms	4	7/8-in Cigar Box Nails						
110	" front of bottoms and felt strips	10	½-in. " " "						
111	" Glass Stops	15	½-in No 20 Brads						
112	" Base Braces	4	3d coated Nails						
113	" Brackets for Equalizer	1	½-in No 16 F H bright						
114	Roller Screws	2	No. 9715, special Roller Screws						
176	Book Guards for H Units	2	15-in long						
178	Door Catch for G W. Lock	1							
179	Screws for Locks	5	½-in No 4 R H blue Screw						
180	Nails for Base Lock	2	1¼ " 13 Escutcheon Pins						
181	" "	3	½ " 16 F H bright						
182	" Lock	4	1 " 16						
183	Guard for Vertical Rod	1							
184	" Base Rod	1							
185	G-W. Base Lock for C	1							
186	" " D	1							
187	" " E	1							
188	" " G	1							
189	" " H	1							

FIG. 73. Stores Withdrawal Report. Hardware. (See § 56.) Suggested size, 8" x 12".

BILL OF MATERIAL, WEAVING.

SHUTTLEWORTH BROTHERS COMPANY

Quality _____ Width _____

Yards woven _____ Cost Period No. _____

QUANTITY	DESCRIPTIVE	PRICE	EXTENSION
	Worsted 12/2/2		
	" 16/2/3		
	" 13/2/3		
	Wool Yarn		
	Cotton 8/3		
	" 8/4		
	Linen 5½ lea		
	Jute		
	Selvedge Cord		
	Total Material used		
	Worsted Waste		
	Linen and Cotton Waste		
	Sweepings		
	Total wastes		

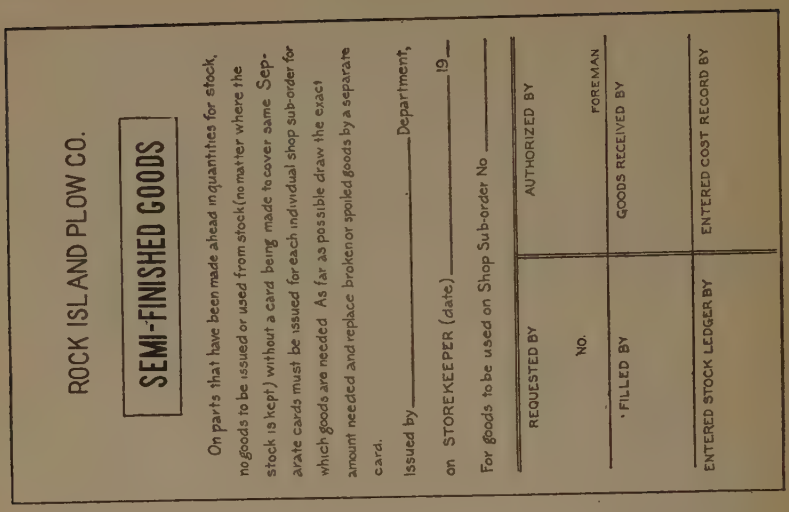
Fig. 74. Bill of Material. Weaving. (See § 313.) Suggested size, 6″x9″.

THE CINCINNATI MILLING MACHINE CO. Sheet No. _____

Requisition for Parts and Material for assembling Shop Order No. _____

	Part No.	Dw'g Room	NAME OF PART	No. in Stock	No. Ordered	Date Due	✓	Date Issued	Quantity	

FIG. 75. Bill of Material. Machinery. (See §§ 55, 56, 313.) Suggested size, 8″x26 lines.


ROCK ISLAND PLOW CO.

SEMI-FINISHED GOODS

On parts that have been made ahead in quantities for stock, no goods to be issued or used from stock (no matter where the stock is kept) without a card being made to cover same. Separate cards must be issued for each individual shop sub-order for which goods are needed. As far as possible draw the exact amount needed and replace broken or spoiled goods by a separate card.

Issued by _____ Department,

on STOREKEEPER (date) _____ 19__

For goods to be used on Shop Sub-order No _____

REQUESTED BY

No.

FILLED BY

ENTERED STOCK LEDGER BY

AUTHORIZED BY

FOREMAN

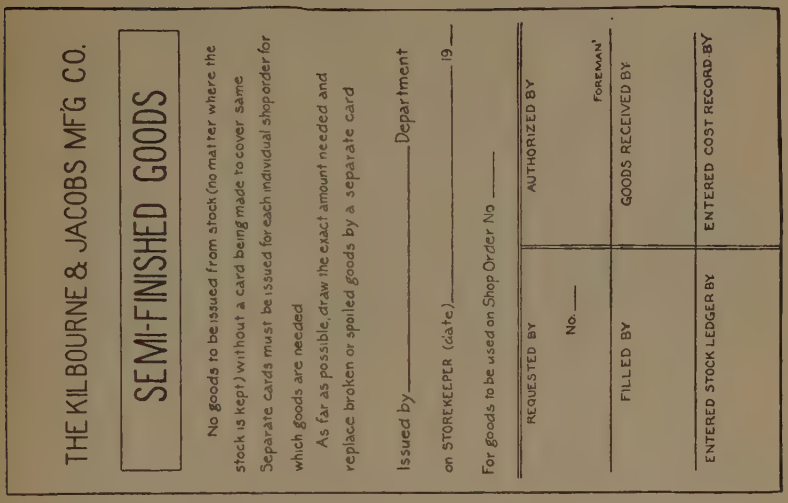
GOODS RECEIVED BY

ENTERED COST RECORD BY

FIG. 76. Semi-finished Goods Card—Front. (See §§ 55, 56.) See size below.

PART	TO BE USED ON		WHERE FROM		PIECES	COST RECORD		
	NO	SYMBOL	DEPT	BIN		PRICE	PER	EXTENSION

FIG. 77. Semi-finished Goods Card—Back. Suggested size, 4"x6½".



THE KILBOURNE & JACOBS MFG CO.

SEMI-FINISHED GOODS

No goods to be issued from stock (no matter where the stock is kept) without a card being made to cover same. Separate cards must be issued for each individual shop order for which goods are needed.

As far as possible, draw the exact amount needed and replace broken or spoiled goods by a separate card.

Issued by _____ Department

on STOREKEEPER (date) _____ 19__

For goods to be used on Shop Order No. _____

REQUESTED BY No. ____	AUTHORIZED BY FOREMAN
FILLED BY	GOODS RECEIVED BY
ENTERED STOCK LEDGER BY	ENTERED COST RECORD BY

Fig. 78. Semi-finished Goods Card—Front. (See §§ 55, 56.) See size below.

PART	SIZE	SYMBOL	PIECES	Dept	BIN	COST RECORD PRICE	PER	EXTENSION	

Fig. 79. Semi-finished Goods Card—Back. Suggested size, 4″x6½″.

THE MARION STEAM SHOVEL CO
MARION, OHIO.

Cost Department:— Date _____ 19__

The following named finished parts have been received from Department _____ and stored for future issuance on Finished Parts Card.

_____ Storekeeper

Date	Stores Order No.	Part	Size	For Machine No.	No. Pieces	Stored	Price	Value

MILLER, DU BRUL & PETERS MFG. CO.

Date _____ 191__

Cost Department:—

I hand you herewith the following named material coupons for which material has been issued.

_____ Storekeeper

Order No.	Goods in Process Dr.	STORE ROOM CR.							
		Iron G'st'gs	Steel C'st'gs	Mall. C'st'gs	Brass C'st'gs	Bar Steel	Bar Iron	Screws	Sundry Material

FIG. 80. (Upper) Summary of Parts Received, (See § 56.) Suggested size, 7"x8".

FIG. 81. (Lower) Material Coupon Summary. (See § 56.) Suggested size, 7"x8".

ROCK ISLAND PLOW COMPANY

Cost Department ——— Date _____ 19__

I hand you herewith the following named Requisitions from Department _____ Stores Department _____

_____ Storekeeper

Date	Form Symbol h	i	j	l	x	Order No. or Account No.	CREDITS TO STORES DEPARTMENT Finished Parts	Factory Supplies	Foundry Supplies	Lumber	Iron and Steel	Sundries

ROCK ISLAND PLOW COMPANY

DEPARTMENT _____ Date _____ 19__

The Cost Dep't were this day given filled Requisitions from Department _____ Stores Department _____

_____ Storekeeper

Date	Form Symbol h	i	j	l	x	Account No. or Order No.	
							The Requisitions listed hereon were duly received for the Cost Dept. by _____

FIG. 82. (Upper) Summary of Requisitions—Original. (See § 56.)
FIG. 83. (Lower) Carbon Copy Form for Summary of Requisitions. Suggested size, 7"x8".

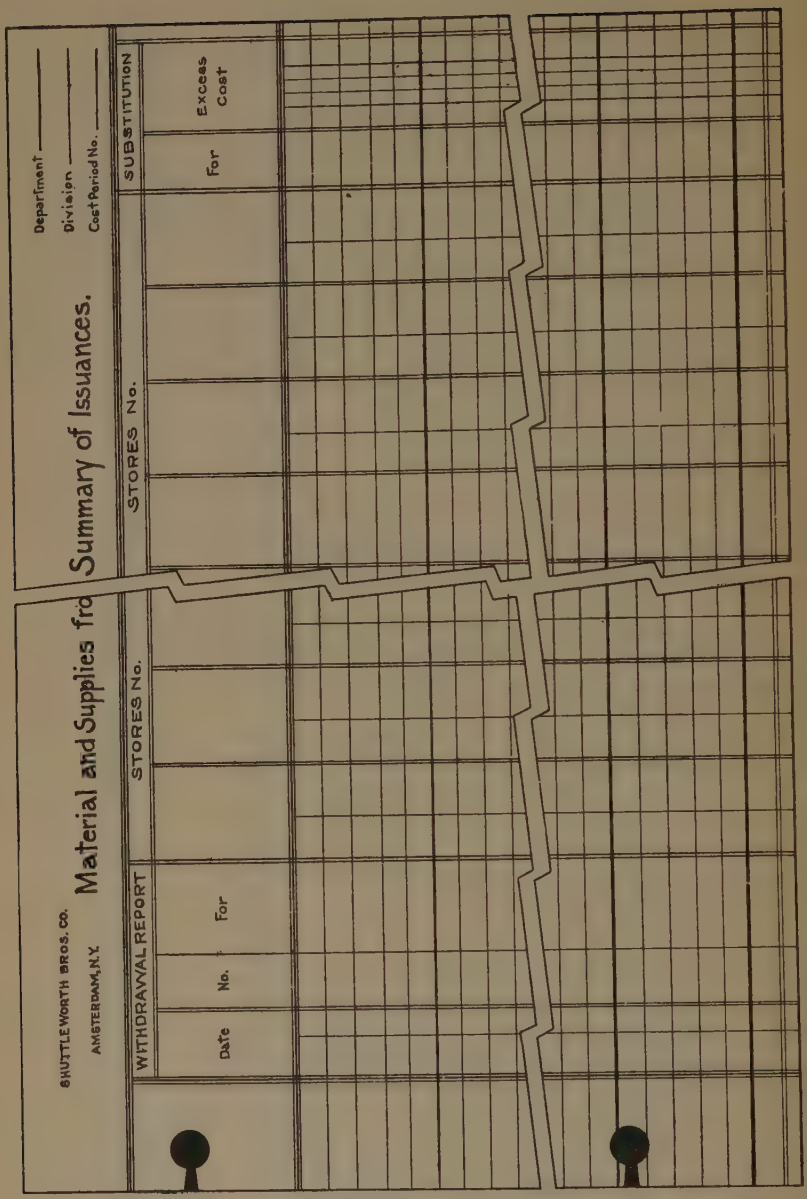


FIG. 84. Summary of Material Issuances. (See § 313.) Suggested size, 18″x40 lines.

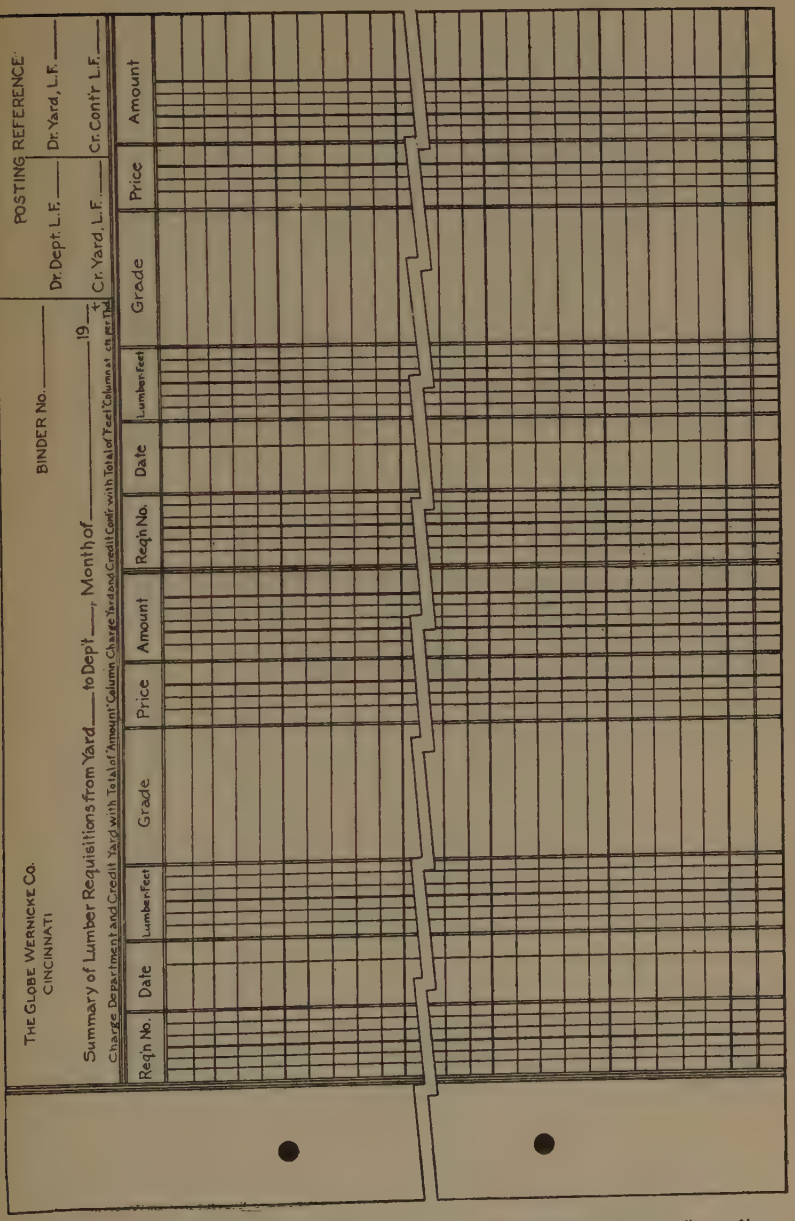

THE GLOBE WERNICKE CO.
CINCINNATI
BINDER No.
POSTING REFERENCE
Dr. Dept. L.F.
Dr. Yard, L.F.
Cr. Yard, L.F.
Cr. Contr L.F.
Summary of Lumber Requisitions from Yard to Dep't, Month of 19
Charge Department and Credit Yard with Total of Amount Column. Charge Yard and Credit Contr. with Total of Feet Columns at cts per M
Reqn No.
Date
Lumber Feet
Grade
Price
Amount

FIG. 85. Summary of Lumber Requisitions. Suggested size, 13″x41 lines.

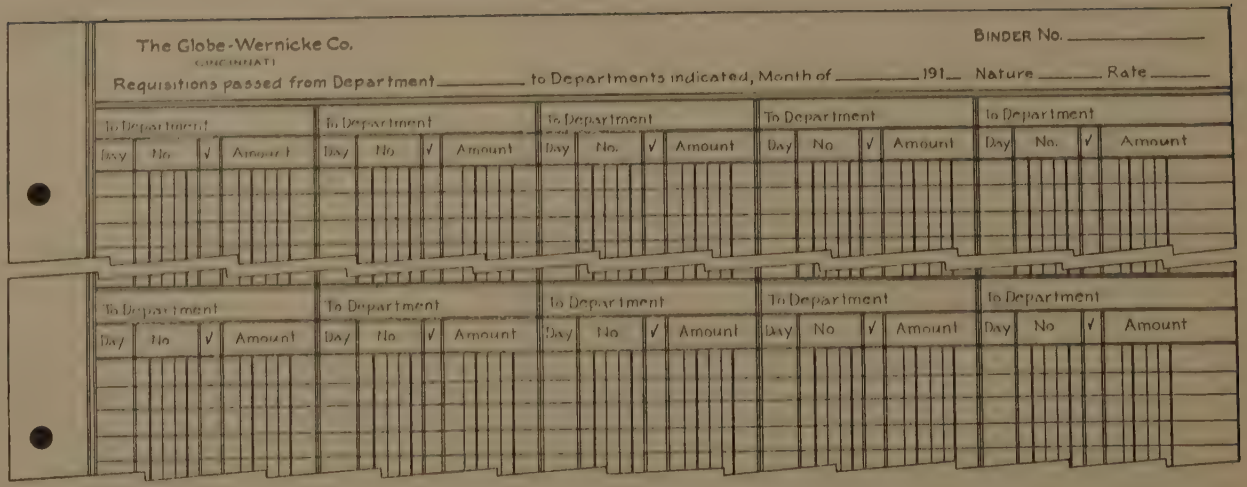
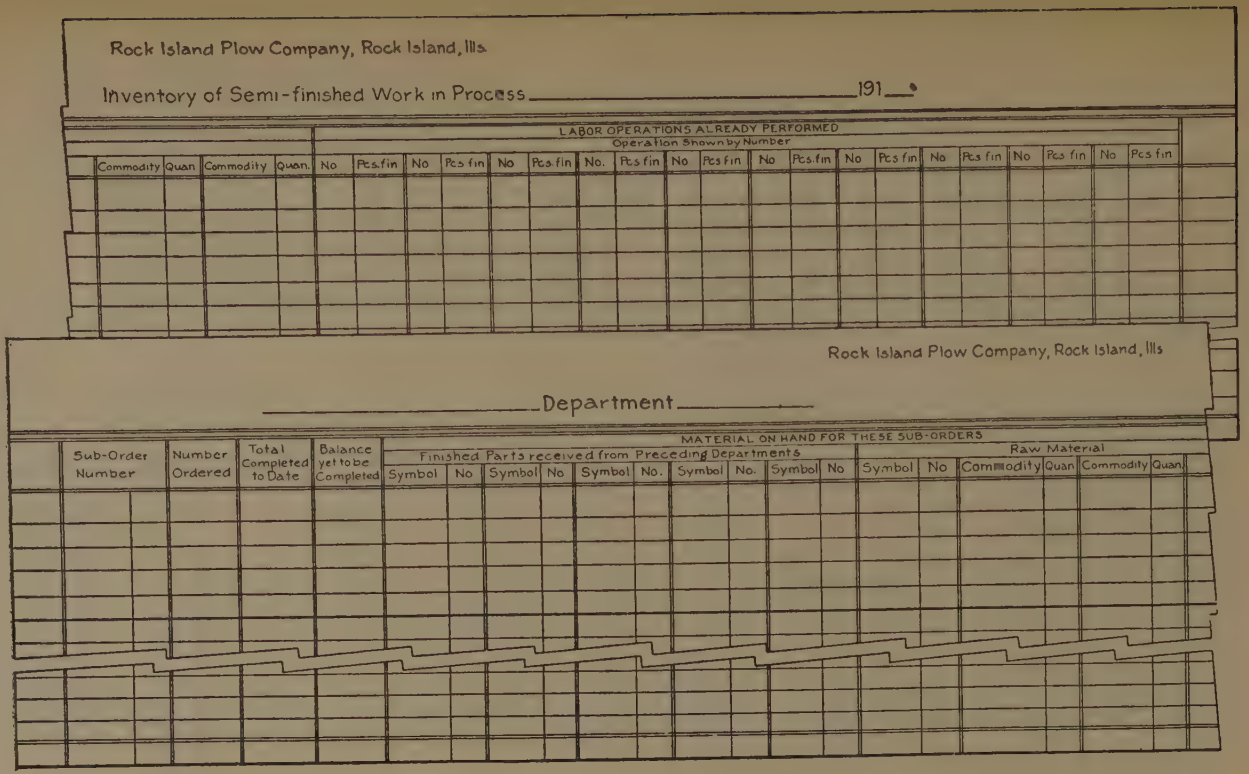
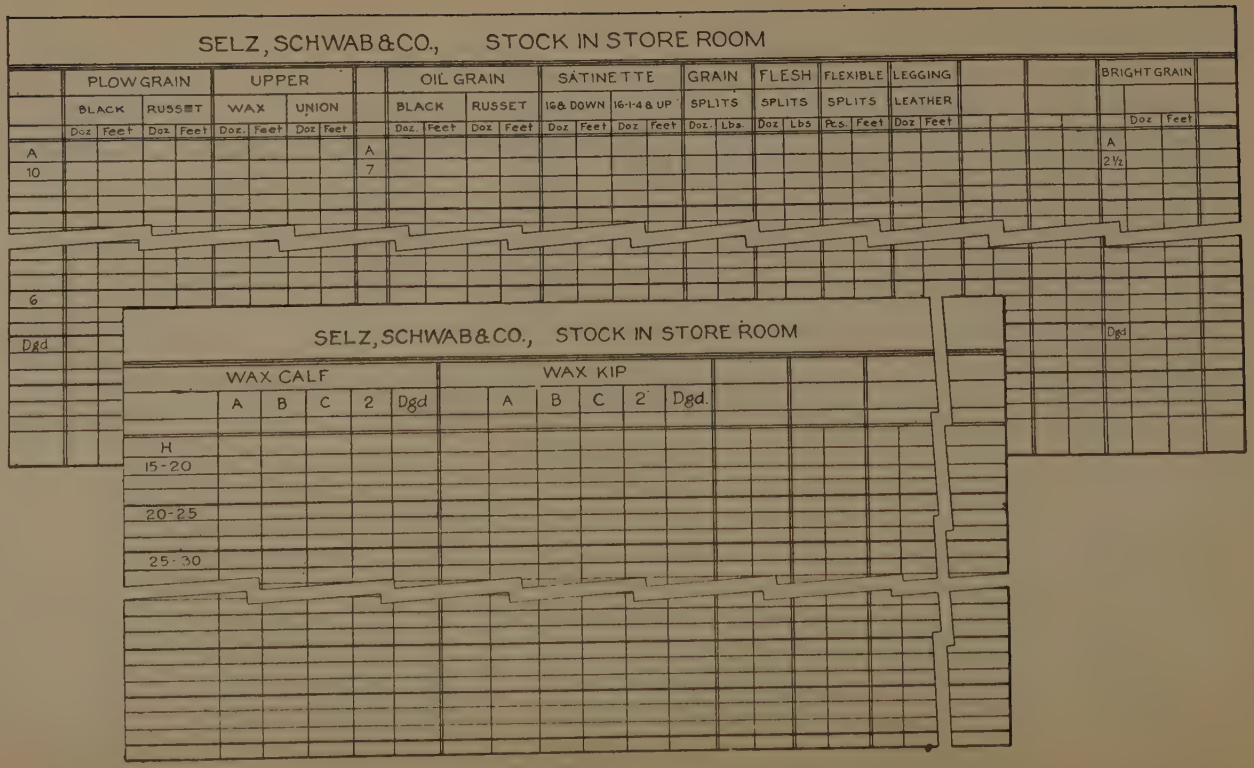


Fig. 86. Summary of Requisitions Between Departments. Suggested size, 14"x11".



FIGS. 87 (Lower), 88 (Upper). Inventory of Work in Progress. (See §§ 235, 313.) Suggested size, 24"x41 lines.



FIGS. 89 (Upper), 90 (Lower). Inventory of Shoe Leather—Face and Reverse of Page. (See § 235.)
Suggested size, 14″x16″.

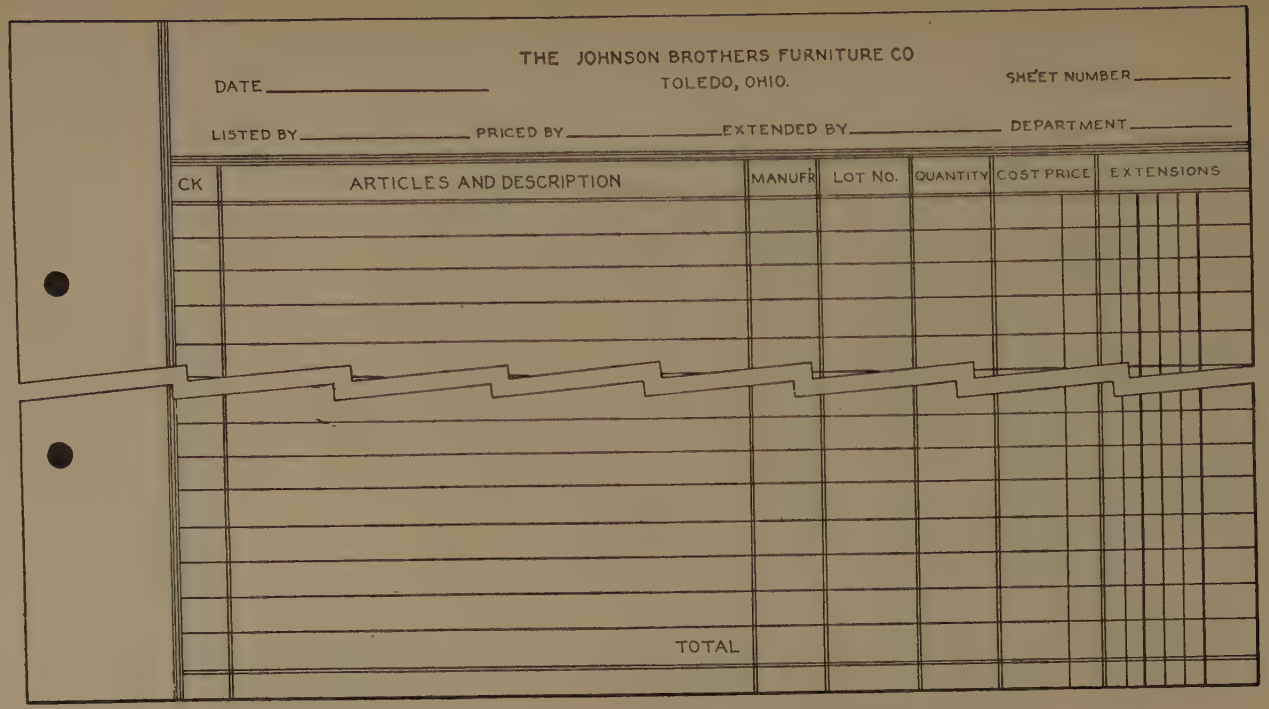


FIG. 91. Inventory: Simple Form. (See § 235.) Suggested size, 11"x31 lines.

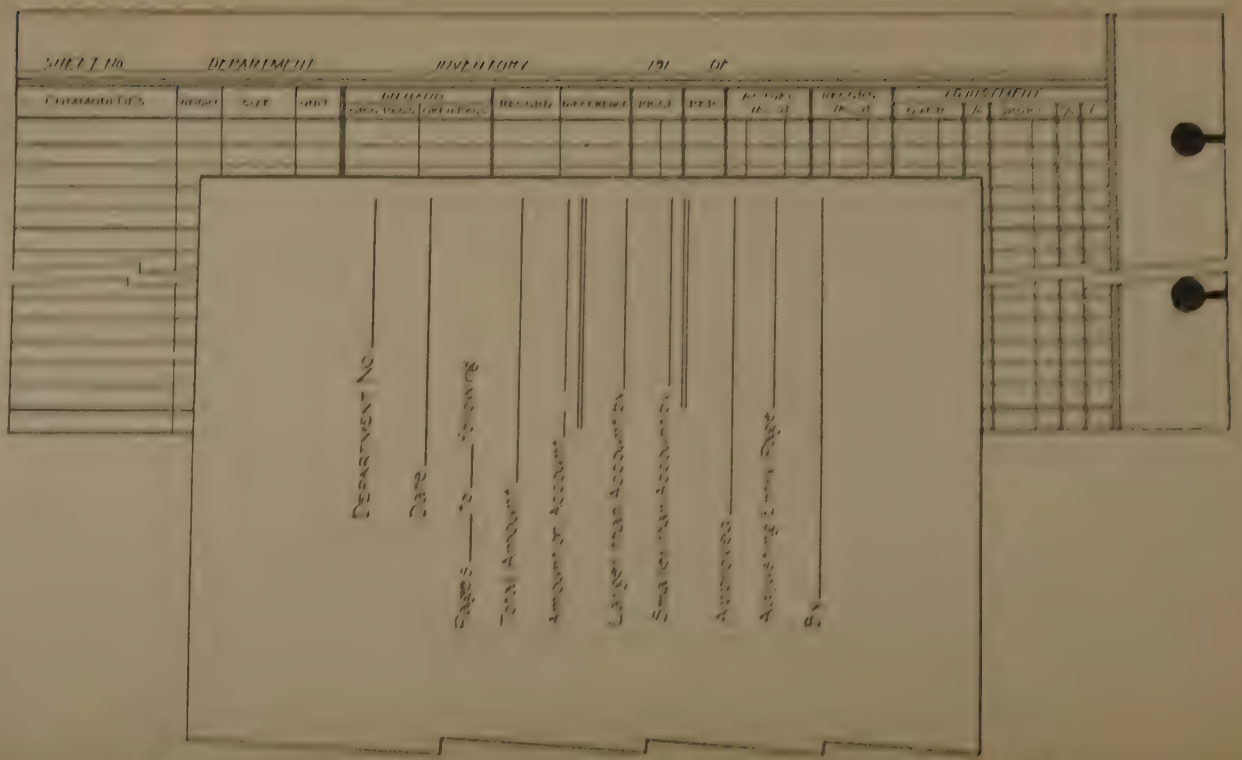


Fig. 92. Inventory with Adjustment Columns. (See § [illegible]) Suggested size, [illegible] Sheet [illegible]

INVENTORIES.

The Globe-Wernicke Co.

Merchandise and goods in process in the various and several departments must be inventoried against Ledger balances on the first working day of the months indicated, and particular care must be used at Inventory time by Contractors, and others concerned, in properly reporting all partial deliveries on Schedules, or Requisitions, where same are not completely filled and therefore cannot be passed in for credit in their entirety.

ORDER OF INVENTORIES.

JUNE.	Departments B, H, K, M and Y. Bookcase Merchandise. B Machinery.
JULY.	Departments C, J, K, V and Y. Filing Cabinet Merchandise. R and Y Machinery.
AUGUST.	Departments A, D, K, S, W. and Y Desk Merchandise. A and K Machinery.
SEPTEM.	Departments, E, G, K, N, R and Y. Stationery Merchandise, Supply Merchandise. E and J Machinery.
OCTOBER.	Departments B, H, K, M and Y. Bookcase Merchandise. G and N. Machinery.
NOVEM.	Departments C, J, K, V and Y. Filing Cabinet Merchandise. W Machinery.
DECEM.	Departments A, D, K, S, W and Y. Desk Merchandise. M and H Machinery.
JANUARY.	Departments E, G, K, N, R and Y. Stationary Merchandise, Supply Merchandise. V Machinery.
FEBRUARY.	Departments B, H, K, M and Y. Bookcase Merchandise C Machinery.
MARCH.	Departments C, J, K, V and Y. Filing Cabinet Merchandise. D Machinery.
APRIL.	Departments A, D, K, S, W and Y Desk Merchandise S Machinery.
MAY.	Departments E, G, K, N, R and Y. Stationary Merchandise, Supply Merchandise. Dormant Machinery. Equipment.

MANUFACTURING DEPARTMENTS.

CARTHAGE AVENUE WORKS.

C. A. W.

DEPARTMENT	A.	Box Mill.
"	B.	Manufacturing Bookcases.
"	C.	" Filing Cabinets.
"	D.	" Desks
"	H.	" Hardware
"	J.	Glass, Paint and Hardware Stock.
"	K.	Lumber in yard and Dry Kilns.
"	M.	Machine Shop
"	S.	Receiving and Shipping.
"	V.	Veneer Works.

EIGHTH STREET WORKS.

E. S. W.

DEPARTMENT	E.	Board and Paper Stock.
"	G.	Manufacturing Supplies and Box Files
"	N.	Machine Shop.
"	R.	Receiving and Shipping.
"	W.	Special Woodwork.
"	Y.	Lumber in Yard and Dry Kilns

INDEX OF INVENTORY MONTHS.

DEPARTMENT	A.	Aug, Dec, Apr.
"	B.	June, Oct. Feb.
"	C.	July, Nov. Mar.
"	D.	Aug, Dec., Apr.
"	E.	Sept., Jan., May
"	G.	Sept, Jan., May
"	H.	June, Oct., Feb.
"	J.	July, Nov, Mar.
"	K.	Every month
"	M.	June, Oct., Feb.
"	N.	Sept., Jan., May
"	R.	Sept, Jan., May
"	S.	Aug, Dec., Apr
DEPARTMENT	V.	July, Nov. Mar.
"	W.	Aug, Dec., Apr
"	Y.	Every month
Bookcase Mdse.		June, Oct, Feb.
Filing Cabinet Mdse		July, Nov, Mar
Stationery Mdse		Sept., Jan., May
Supply Mdse		Sept, Jan., May
Desk Mdse.		Aug, Dec., Apr
A. Machinery		Aug.
B. "		June
C. "		Feb.
D. "		March
E. "		Sept.
G. Machinery,		Oct.
H. "		Dec.
J. "		Sept.
K. "		Aug.
M. "		Dec.
N. "		Oct.
R. "		July
S. "		April
V. "		Jan.
W. "		Nov.
Y. "		July
DORMANT MACHINERY		May
EQUIPMENT.		May

BRANCHES.

JANUARY, MAY, SEPTEMBER: Bookcases, Supply Goods.
FEBRUARY, JUNE, OCTOBER: Chairs & Lounges, Desks & Tables.
MARCH, JULY, NOVEMBER: Filing Cabinets, Sundry Merchandise.
APRIL, AUGUST, DEC.: Stationers Goods, Office Furniture & Fixtures.

FIG. 95. Inventory Time Schedule. (See § 235.)

CHAPTER XXXIX.

FORMS RELATING TO LABOR.

§ 315. Comment on Forms of Chapter.*

Forms relating more or less directly to labor, but not included in the present chapter, will be found under Figures 13 to 15 (§ 90), 22 and 23. Chapters VIII to X treat generally of the labor records. Mechanically recorded time reports are treated in a general way in §§ 60 to 63, and 66. Time reports—hand written or indicated—are treated generally in §§ 59 to 68.

Figures 96, 97. Time Work on Specific Orders—obverse and reverse. This form is one that may be used both for pay purposes and for applying the labor cost against the proper order number. All beginnings, endings, interruptions, resumptions, or other designations for the stopping and starting of work, can be recorded on this form during the two weeks which constitute a given pay period. The three sets of "on and off" are respectively for morning, afternoon, and overtime, or interruptions.

Figure 111. Plan Number Assignment Card. When several different plans of time reporting and cost finding are employed in the same plant, it usually becomes necessary to advise each individual workman as to the requirements of time reporting. This is desirable in order that he may not be confused or misled by mistaken information given him by his fellow workmen. Figure 111 is used for this purpose.

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 316.

Figure 112. Request for Prepared Time Cards. Where time cards are mechanically numbered in advance of use, with the employee's number and are also printed with his name—by means of a special device for the purpose—it is necessary to make preparation sufficiently far ahead to prevent delays from lack of cards. This is accomplished by having each department clerk (or person handling shop orders) anticipate his needs as to quantity and form of card ("N," "O," "P," "Q," "R" being form symbols in the illustration) for each workman.

In some cases workmen may use but one card for the period, while in other cases three or four dozen cards may be used during the same period, depending entirely upon the class of work each particular workman is on—items which the clerk must take into consideration in making out his order. He must also take into consideration the stability of the workmen and not order too many cards for men likely to drop out. "Overs" are not wasted, however, as an interchangeable rubber stamp of heavier type than the original impression, can be used to obliterate the first record.

Figure 115. Job Ticket—for one day only. This particular form lists labor, machine time, and expense constant separately, thus entailing several mathematical calculations. Two registrations in one day are possible with this form. For instance, on the first registration "On" time is entered under "Begun"; and "Off" time is entered under "Interrupted"; on the second registration "On" time is entered under "Resumed"; and "Off" time is entered under "Unfinished" (for day), or under "Operation Finished," or "Job Finished," as the case may be. Where a job is unfinished at the end of the day, the "Off" or stopping time is put under "Unfinished" and the next day's time is shown under "On," as "Continued."

Figure 116. Job Ticket—for one day only. Time on this ticket is indicated by a check mark in one or another of the fifteen minutes' period sections. It is possible to record on it one or more interruptions of quarter hours or longer

duration. On this form new jobs which have just been begun are indicated by a cross marked in the space shown under "Date."

Figure 118. Daily Time Report—work on process goods. On this report, time is indicated decimally and the process is indicated by symbols. In calculating elapsed time, the number of units indicated at the starting of a given job is subtracted from the number of units indicated at the finish of the job; and the remainder is multiplied by six (the number of minutes in one unit) to find the total number of minutes elapsed.

Figure 119. Labor and Machine Time Record. This record covers possible interruptions—of not less than a quarter of an hour—throughout a twelve-hour day and for seven consecutive days. The dual time indications are made by checks against the column lines indicating the nearest quarter-hour period to the starting and stopping times respectively. In the form shown, the full hours and the half hours are indicated, but the quarter and three-quarter hours are not indicated for lack of space.

Figure 122. Daily Time Report. Used for numerous jobs of a process nature. Frequently forms of this kind are used where the men's hands are in such condition that the form cannot be handled without injury unless protected in some way. In such cases the form may be rolled round a wooden platen with knobs at the end by which it can be turned. This platen is enclosed in a box with a top made of two glass panes or plates, so separated that the writing line is uncovered while the rest of the form is completely protected. This arrangement preserves the form in good condition and also precludes the necessity of a desk, the "boxed" form being fastened to the wall. The platen can be turned backward or forward at will.

Figures 124 and 125. Weekly Machine Time Report (obverse and reverse)—with coupons specifically arranged for each day. This form is particularly applicable to the

machine-hour plan (Chapters XXIII to XXVII) where machines are arranged in industrial centers and all engaged in similar work. The form is printed on manilla cardboard and is further prepared for use by means of a numbering stamp with which the individual machine number is stamped on the stub and on every coupon of the card. The first stub of the report is detached and retained in a card tray in the cost department for identification purposes. Being slightly higher than the coupons (when detached) it acts as a guide for them when they are filed in the card index. The "Saturday" coupon is punched with a hole, enabling the entire card to be hung up on a convenient hook. The coupons are detached from day to day and turned in, giving a report of the day's production, together with a report of any idle time and time spent on preparatory work.

§ 316. Forms Used in Connection with Labor.

TIME WORK ON JOBS
TURN THIS SIDE IN
Form P Man No. _____ PAY ENDING
DEPARTMENT _____ _____
_____ _____
NAME _____
THE MARION STEAM SHOVEL CO.

DAY	ON	OFF	ON	OFF	ON	OFF	HRS
MON							
TUE							
WED							
THU							
FRI							
SAT							
SUN							
MON							
TUE							
WED							
THU							
FRI							
SAT							
SUN							

RATE ____ HOURS ____ $ ____
ENTERED EMPLOYE'S RECORD ____
ENTERED PRODUCTION REGISTER ____

Fig. 96. Time Work on Specific Order—Front. See size below. (See § 315; also Chs. VIII, XXVI.)

Machine Order No. _____ | Group
Repair Order No. _____
Stock Order No. _____
Style No. _____ Part No. _____
Job No. _____ Operations _____

Crew Chief on this Job is No. _____
Numbers of workmen employed on this job _____

Quantity ordered _____
Quantity unfinished from last card _____
Quantity finished on this card _____
Quantity carried to next card _____

Estimated total time necessary _____ Hrs.
This card started with job 1/8 1/4 3/8 1/2 5/8 3/4 7/8 Finished
This card closes with job 1/8 1/4 3/8 1/2 5/8 3/4 7/8 Finished

Remarks _____

Fig. 97. Time Work on Specific Order—Back. Suggested size, 3⅜"x7".

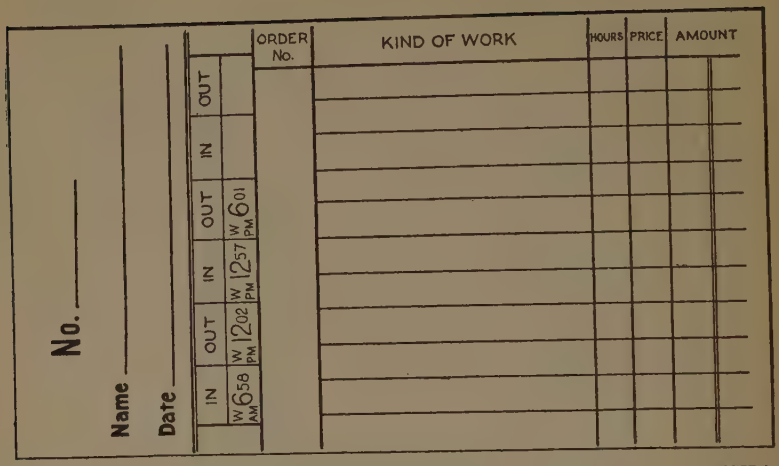


Fig. 98. In and Out Card. Report of Work Done. (See Chs. VIII, XXVI.) Suggested size, 4″x6½″.

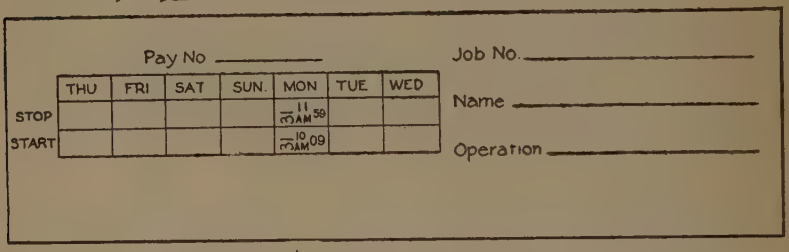


Fig. 99. Start and Stop Card. (See Chs. VIII, XXVI.) Suggested size, 8″x2⅜″.

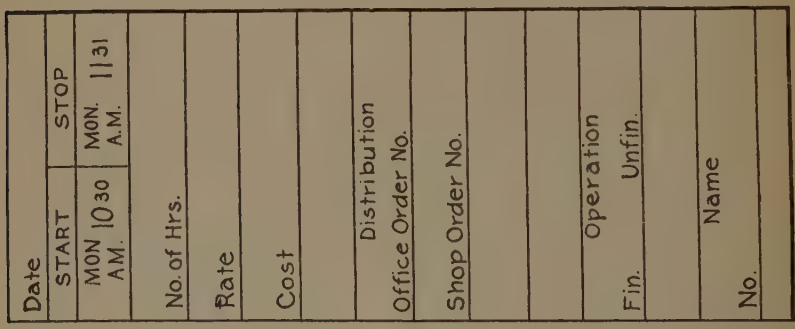


Fig. 100. Start and Stop Card. One Job. Suggested size, 2⅛″x5″.

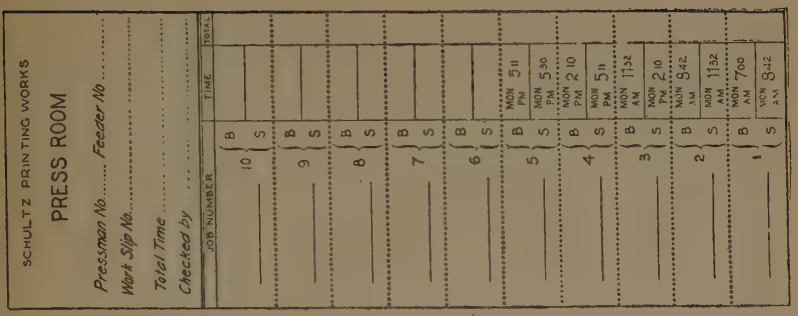

SCHULTZ PRINTING WORKS
PRESS ROOM
Pressman No..... Feeder No.....
Work Slip No.....
Total Time .....
Checked by .....
JOB NUMBER
TIME
TOTAL
10 B S
9 B S
8 B S
7 B S
6 B S
5 B S MON PM 5 11 MON PM 5 30
4 B S MON PM 2 10 MON PM 5 11
3 B S MON AM 11 32 MON PM 2 10
2 B S MON AM 9 42 MON AM 11 32
1 B S MON AM 7 00 MON AM 8 42

FIG. 101. Start and Stop Card. Ten Jobs. (See Chs. VIII, XXVI.) Suggested size, 4"x10".

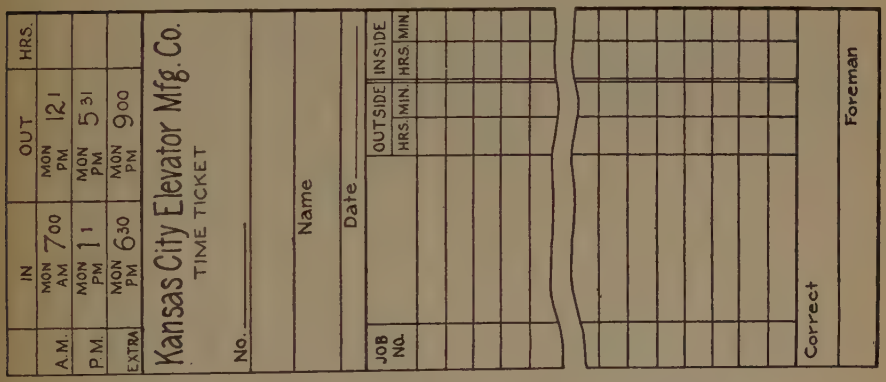


FIG. 102. Start and Stop Card. Written Distribution. (See Chs. VIII, XXVI.) Suggested size, 2⅞"x7".

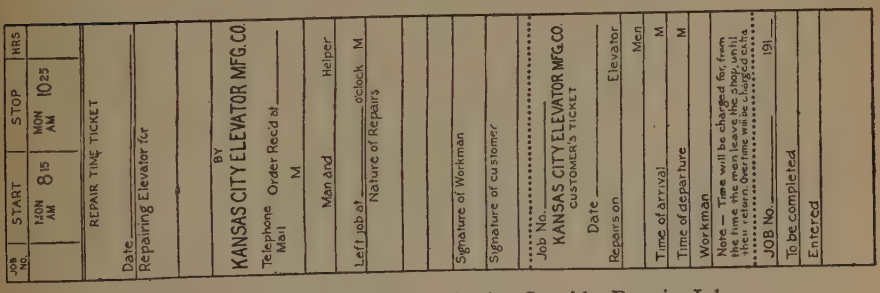


FIG. 103. Start and Stop Card. Outside Repair Job. (See Chs. VIII, XXVI.) Suggested size, 2⅞"x9½".

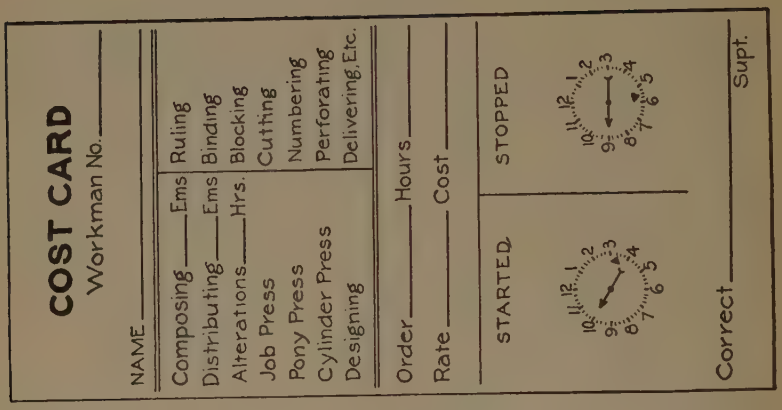


FIG. 104. Time Stamp Card. One Job—Front. (See Chs. VIII, XXVI.) See size below.

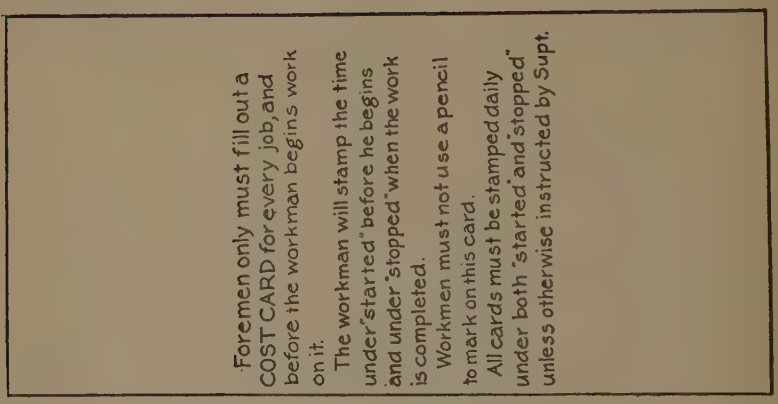

Foremen only must fill out a COST CARD for every job, and before the workman begins work on it.
The workman will stamp the time under "started" before he begins and under "stopped" when the work is completed.
Workmen must not use a pencil to mark on this card.
All cards must be stamped daily under both "started" and "stopped" unless otherwise instructed by Supt.

FIG. 105. Time Stamp Card. One Job—Back. Suggested size, 3"x6".

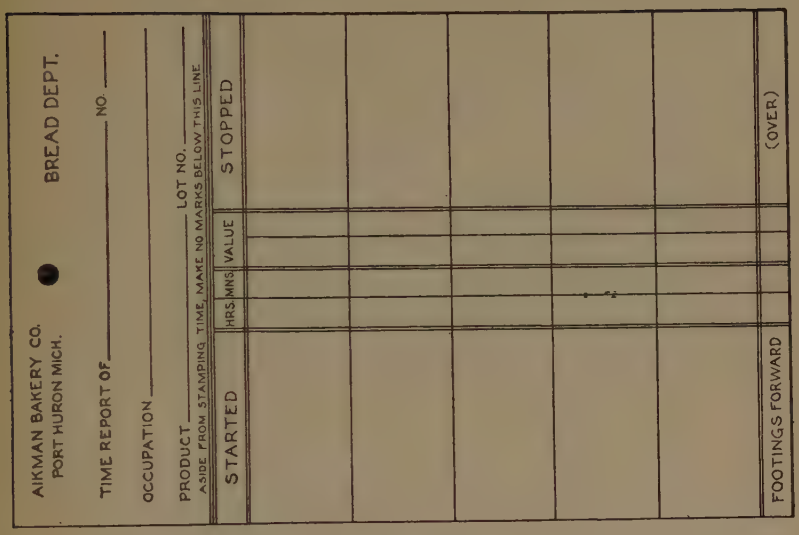


Fig. 106. Time Stamp Card. Ten Jobs—Front. (See Chs. VIII, XXVI.) See size below.

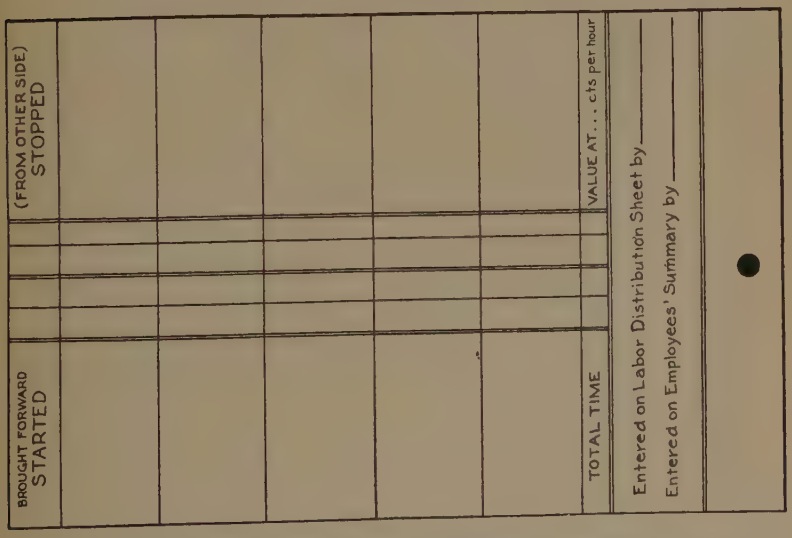


Fig. 107. Time Stamp Card. Ten Jobs—Back. Suggested size, 4"x6".

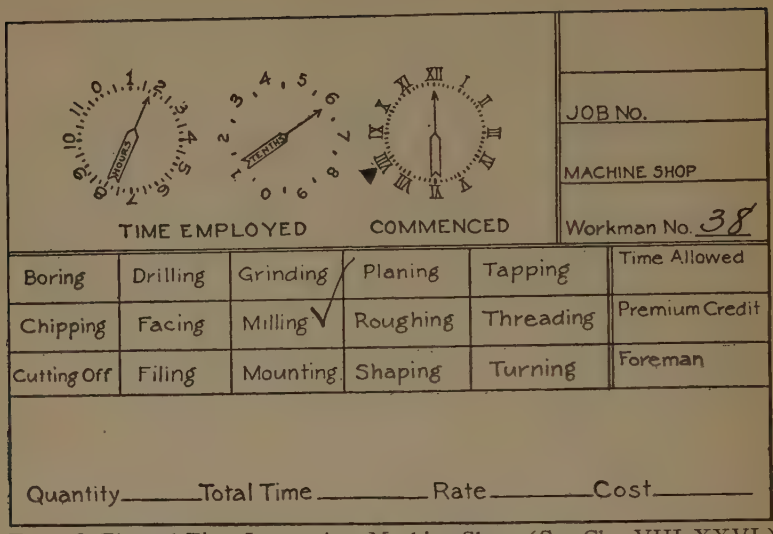
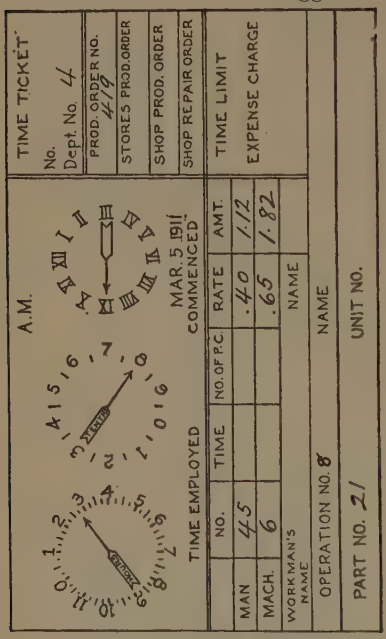


FIG. 108. Elapsed Time Impression. Machine Shop. (See Chs. VIII, XXVI.) Suggested size, 5"x3".



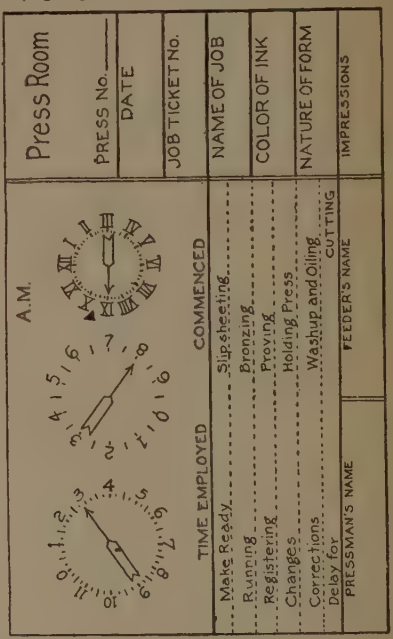


FIG. 109 (Left). Elapsed Time Card. Machine and Operator. (See Chs. VIII, XXVI.) Suggested size, 5"x3".
FIG. 110 (Right). Elapsed Time Impression. Press-Room. (See Chs. VIII, XXVI.) Suggested size, 5"x3".

Time Recording Assignment Card.

TIME PLAN No. 4

Name _____

Beginning with _____

your TIME RECORDING CLOCK NUMBER will be _____

on Clock No. 5 which is located at TOWER

You will ring in and out, morning noon and night and any other time on a card this size and color and known as Form P, if you are working time work, or on a green card similar to this card and known as Form O, if you are working piece work. There is no difference in the printing of the two cards except the space on Form O, for piece work job numbers and for premium earnings.

You will take care to see that the numbers of all the men in your crew are recorded on the back of your job card; omissions of such numbers will only cause delays and will avail you nothing but will show upon the office records as negligence on your part in not detecting such omissions. The men in your crew each have their individual instructions and they will not have to ring on each individual job as you are required to do

A card bearing your number, also the number of the order you are to work on will be prepared by me, and will be given to you for each job you are set at; when you are about to start on a job you will immediately proceed to your Time Recording Clock and ring "On" the job depositing the card in the "In" rack When you cease work on the job at noon, at night or at any other time you will remove the card from the "In" rack, register the time upon it and place it in the "Out" rack, provided you expect to continue on the job upon your next return, if the job is finished or temporarily suspended you will deposit it in the "Jobs Finished" box or in the "Temporarily Suspended" box as the case may be, and report to me or to my clerk for a new Job Card.

Upon your arrival at the works ready for work in the morning afternoon or at any other time, you will remove your current job card from the "Out" rack register your time upon it, and place it in the "In" rack.

Your earnings for each two weeks are computed upon such cards as you record your time on and your pay envelope made therefrom, and you therefore are cautioned against failure to register as the Company will pay you for only such time as you are registered as being on duty.

_____

Foreman

Approved _____

Supt

FIG. 111. Plan Number Assignment Card. (See § 315.)
Suggested size, 3⅞″x7″.

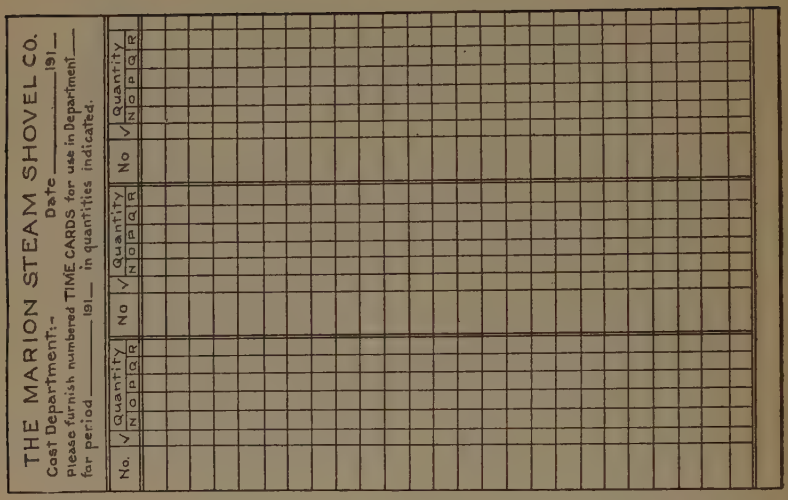


Fig. 112. Request for Prepared Time Cards. (See §§ 265, 315.) Suggested size, 5″x8″.

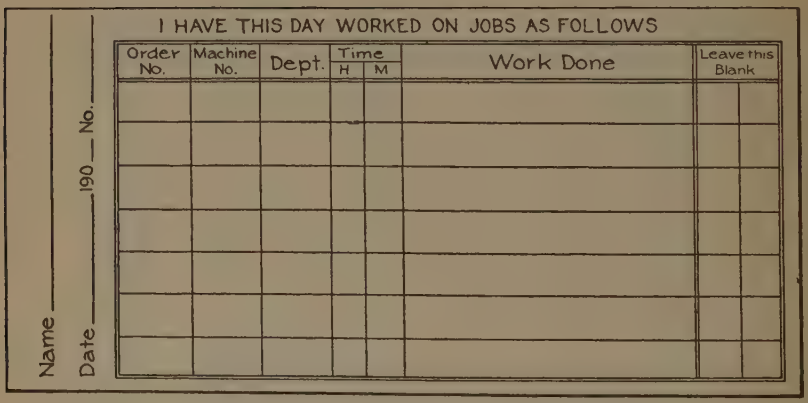


Fig. 113. Job Report Form for Reverse of any Clock Card. (See Chs. VIII, XXVI.) Suggested size, 3⅜″x7″.

NAME _____ No. _____

DEPT. _____ RATE _____

DEPARTMENT	Hrs.	Min.	Pc. Work	Time Work
J 1c Box				
2c Printing				
3c Laboratory				
4c Boiling				
5c Drying				
6c Milling				
7c Wrapping				
A A 12 Power				
17 Repairs				
21 Handling stores				
30 Machinery				
34 Handling product				
42 Stable				

REMMERS SOAP CO., Cincinnati, O.

FIG. 114. Departmental Report Form for Reverse of any Clock Card. (See Chs. VIII, XXVI.) Suggested size, 4"x5¾".

MILLER DuBRUL & PETERS MFG. CO.

JOB TICKET

Man No. _____ Name _____ Date _____

Shop Order No. _____ Job No. _____ Mach. No. _____

Operation _____ Name of Piece _____

No. Pcs. to Job _____ Pcs. Finished this Ticket _____ Rejected _____

TIME	MAN RATE	WAGES	MCH. RATE	BURDEN	TOTAL

ON			OFF			
BEGUN	CONTINUED	RESUMED	UNFINISHED	INTERRUPTED	OPERATION FIN.	JOB FIN.

REMARKS.

FIG. 115. Job Ticket for One Day. Time Written (See § 315; also Chs. VIII, XXVI.) Suggested size, 6"x4".

JOB NO.

WAGNER ELECTRIC MFG. CO.
TIME SLIP Motor Assembling Dep't.
PUT ONLY ONE JOB ON THIS SLIP – TURN IN DAILY

DATE

NAME

NO.

DAY WORK

MARK X IN THIS SPACE
DAY JOB IS STARTED ONLY

TYPE & SIZE OF APPARATUS

DRAWING NO. OF PART

NUMBER FINISHED

NAME OF PART

OPERATION

T H ON JOB

HRS.

		15	30	45
A M	7			
	8			
	9			
	10			
	11			
	12			
P M	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
A M	1			
	2			
	3			
	4			
	5			
	6			

FIG. 116. Job Ticket for One Day. Time Indicated. (See § 315; also Chs. VIII, XXVI.) Suggested size, 6″x4¼″.

THE LOWE BROS. CO.
DAYTON, OHIO.

MIXING LABOR

USE A SEPARATE SHEET FOR EACH CLASS OF LABOR EACH DAY

Name _____ No _____ Foreman _____

Approved _____ Hrs. ____ Mins Cost $ _____

Total Time _____

LEAVE THIS BLANK	ORDER NO.	QUANTITY	STARTED	STOPPED	HRS.	MIN.	VALUE
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							
MIXING							

FIG. 117. Daily Time Report. Time Written on Coupons. (See § 212; also Chs. VIII, XXVI.) Suggested size, 5″x7″.

THE BUSY BEE CANDY KITCHEN CO.
Cake Dept.

DAILY TIME SHEET

Name _____ 19____

UNITS	TIME	NAME OF GOODS	KIND OF WORK
0	600		
1	606		
2	612		
3	618		
4	624		
5	630		
6	636		
7	642		
8	648		
9	654		
10	700		
111	506		
112	512		
113	518		
114	524		
115	530		
116	536		
117	542		
118	548		
119	554		
120	600		

M. Mixing
L. Laying out
B. Baking
P. Packing

T. Trimming
S. Setting together
I. Icing
C. Cutting
W. Wrapping

FIG. 118. Daily Time Report. Time Indicated Decimally. (See § 315; also Chs. VIII, XXVI.) Suggested size, 3¾"x15".

D. W. McGRATH, BUILDING CONTRACTOR

Daily Report of Teamster_____ Date _____ 190__

	No Loads	Hours	HAULED FROM	HAULED TO	COMMODITY	RECEIVED BY

TIME AND JOB RECORD

The Dayton Hydraulic Machinery Co.

Date 8/13/10

No. of Pieces	Casting No	Name of Article	Order No
50	B321	Small gear	2764

Check No.	Name of Employee	Mach No	Operation
648	Edw. Grimes	2149	Milling

Pieces Lost ✓	Material CS	Remarks

DATE	6 5:30	6:30	7 7:30	8 8:30	9 9:30	10 10:30	11 11:30	12 12:30	1 1:30	2 2:30	3 3:30	4 4:30	5 5:30	6	TOTAL HOURS
Aug 14			✓					✓	✓		✓				7¼
Aug 15						✓		✓	✓				✓		5¾
Aug 16			✓			✓									3½
															16½

FIG. 119 (Lower). Job Ticket for Week. Time Indicated. (See § 315; also Chs. VIII, XXVI.) Suggested size, 6"x5½".

FIG. 120 (Upper). Daily Time Report. Time Written. (See Chs. VIII, XXVI.) Suggested size, 9"x6".

BINDERY DAILY TIME REPORT

Employe _____ Clock No. _____ Date _____ 191__

"Kind of work" column MUST be filled in, using numbers printed on back of sheet. Make separate report for any overtime work.

	Job No.	For whom	Pages or Signature	Kind of work	Quantity	PIECE-WORK Rate	PIECE-WORK Amount	Time Began	Time Stopped	FOR OFFICE USE Chargeable Hours	FOR OFFICE USE Non-charge Hours
●											

DAILY TIME REPORT

Approved by _____ Foreman

BLACKSMITH SHOP

THE A. A. SIMONDS & SON CO Dayton, Ohio.

Name _____

Date _____ 190__

ORDER No	CLASS	No. PIECES	OPERATION	Proportion	TIME HRS.	TIME MIN.	LABOR COST	ORDER No.	CLASS	NO. PIECES	OPERATION	Proportion	TIME HRS.	TIME MIN.	LABOR COST

FIG. 122. Daily Time Report. Time Written. (See § 315; also Chs. VIII, XXVI.) Suggested size, 14"x8½".

PRESSROOM DAILY TIME REPORT

Press No. _____ Date _____ 191__

"Kind of work" column MUST be filled in, using numbers printed on back of sheet. Make separate report for any overtime work.

	Job No.	For Whom	Pressman	Clock No.	Feeder	Clock No.	Impressions	Lbs. Ink Used	Pages or Color	Kind of Work	Time Began	Time Stopped	FOR OFFICE USE Chargeable Hours	Non-chargeable Hours
●														
●														

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No. ____ Week ____
Name of employee ____
Nature of machine ____
Class of work ____
Any other operations ____
____

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No. ____ SATURDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No ____ FRIDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No. ____ THURSDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No ____ WEDNESDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No ____ Employee No ____ TUESDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

DEPARTMENT ____ DIVISION ____ Card No. 499
Machine No. ____ Employee No. ____ MONDAY
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
Pattern No. ____ Start ____ Stop ____ Hours ____ Yards ____
____ Start ____ Stop ____ Hours ____
Machine Idle: cause ____ Stop ____ Start ____ Hours ____
Remarks may be written on the back hereof

FIGS. 124a (Left), 124b (Right). Weekly Machine Time Report: Daily Coupons—Front. (See §§ 216, 315; also Chs. VIII, XXVI.) Suggested size, 5"x13".

	Time		Time
Creeling	____	Drawing Up	____
Single Stuffer	____ " ____	Piecing Back	____ " ____
Double Stuffer	____ " ____	Slipping	____ " ____
3 ply Stuffer	____ " ____	Samples	____ " ____
Fine chain	____ " ____	Cutting out cards	____ " ____
Changing frames	____ " ____	Tying in cards	____ " ____
Tying in frames	____ " ____	Putting in heddles	____ " ____

Remarks _____

	Time		Time
Creeling	____	Drawing Up	____
Single Stuffer	____ " ____	Piecing Back	____ " ____
Double Stuffer	____ " ____	Slipping	____ " ____
3 ply Stuffer	____ " ____	Samples	____ " ____
Fine chain	____ " ____	Cutting out cards	____ " ____
Changing frames	____ " ____	Tying in cards	____ " ____
Tying in frames	____ " ____	Putting in heddles	____ " ____

Remarks _____

	Time		Time
Creeling	____	Drawing Up	____
Single Stuffer	____ " ____	Piecing Back	____ " ____
Double Stuffer	____ " ____	Slipping	____ " ____
3 ply Stuffer	____ " ____	Samples	____ " ____
Fine chain	____ " ____	Cutting out cards	____ " ____
Changing frames	____ " ____	Tying in cards	____ " ____
Tying in frames	____ " ____	Putting in heddles	____ " ____

Remarks _____

FIG. 125. Weekly Machine Time Report: Preparation—Back. Suggested size, 5"x13".

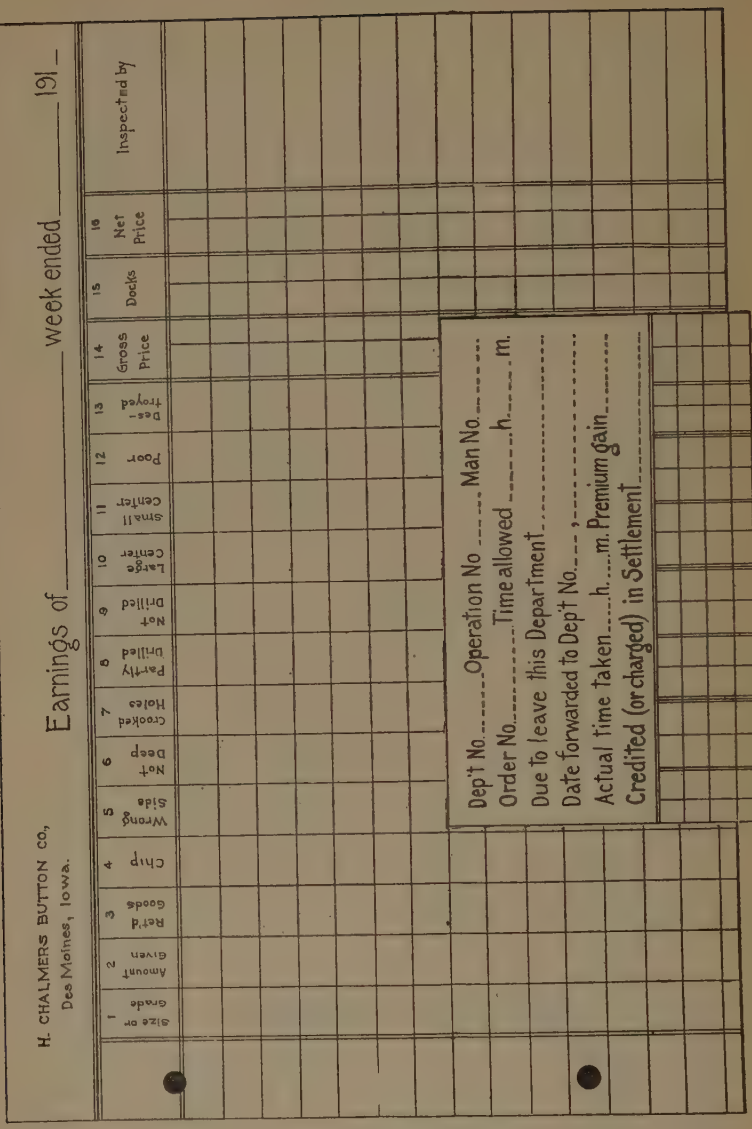


FIG. 126 (Smaller). Premium Earnings Card. (See §§ 32, 35, 36.) Suggested size, 5"x3".

FIG. 127 (Larger). Piece-Work Record for Premium Docks. (See § 74.) Suggested size, 11"x8½".

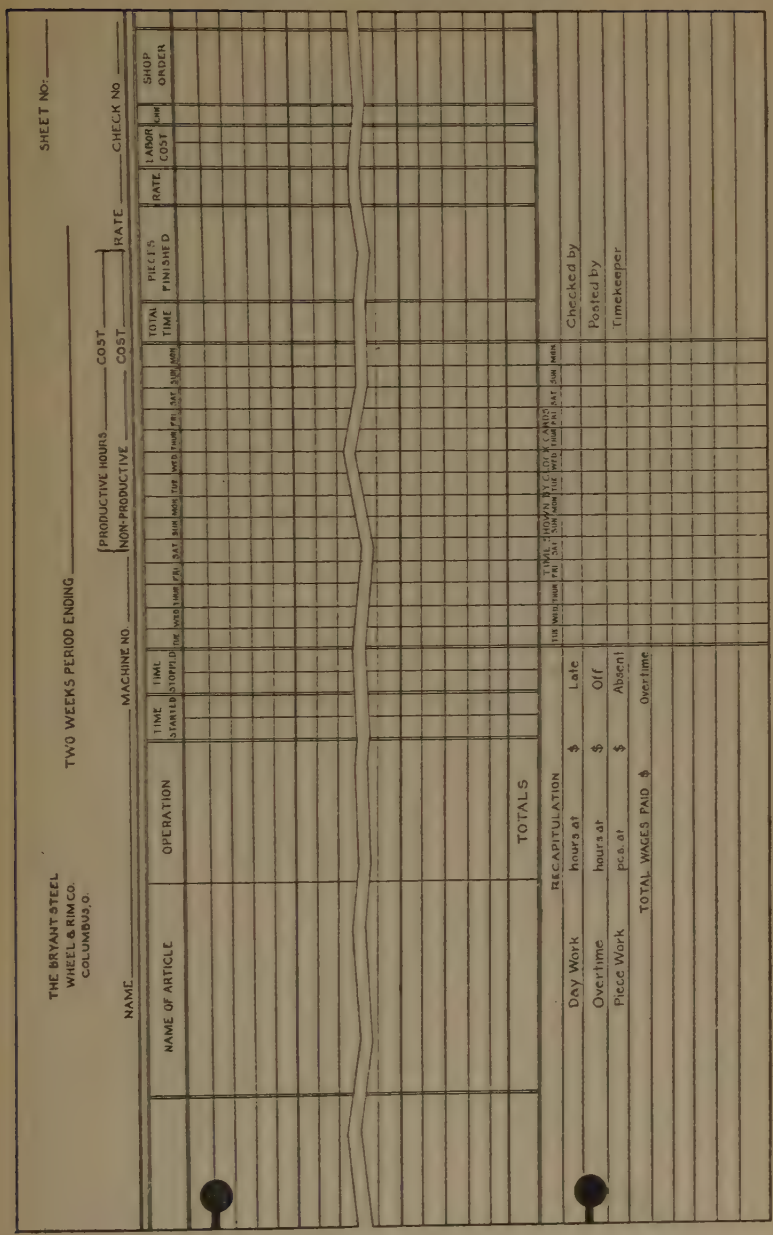


FIG. 128. Time-Keeper's Sheet. (By Order Numbers.) (See §§ 61, 215, 269.) Suggested size, 14"x8½".

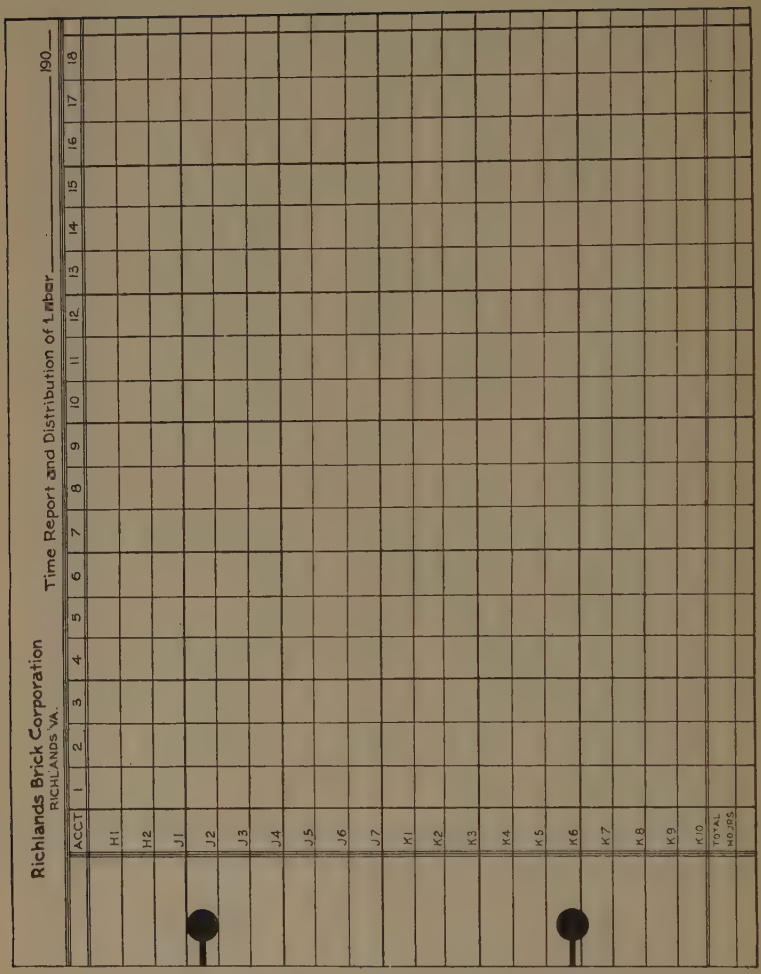


FIG. 129. Time-Keeper's Sheet. (By Processes.) (See §§ 61, 215, 243, 269.) Suggested size, 11″x8½″.

A indicates chargeable hours
B indicates non-chargeable

Record of Employes' Hours, month of _____ 191__

Date	DEPARTMENT 1		DEPARTMENT 2		DEPARTMENT 3		DEPARTMENT 4		DEPARTMENT 5		DEPARTMENT 6		Date
	A	B	A	B	A	B	A	B	A	B	A	B	
1													1
2													2
3													3
4													4
5													5
6													6
7													7
8													8
9													9
10													10
11													11
12													12
13													13
14													14
15													15
16													16
17													17
18													18
19													19
20													20
21													21
22													22
23													23
24													24
25													25
26													26
27													27
28													28
29													29
30													30
31													31
Totals													Totals

FIG. 130. Summary of Productive and Non-Productive Hours. (See §§ 217, 218.) Suggested size, 11″x8½″.

Total Dep't Pay Roll $_____ Avg. Pay Roll cost for A_____

Total chargeable hours (A)_____ Ratio of B to A_____ %

PAY ROLL, Department No._____

For week ended _____ 191__

A indicates chargeable hours; B indicates non-chargeable hours

Clock No.	Name	MONDAY A	MONDAY B	TUESDAY A	TUESDAY B	WEDNESDAY A	WEDNESDAY B	THURSDAY A	THURSDAY B	FRIDAY A	FRIDAY B	SATURDAY A	SATURDAY B	Total A	Total B	Rate	Total Amount	Cost of A

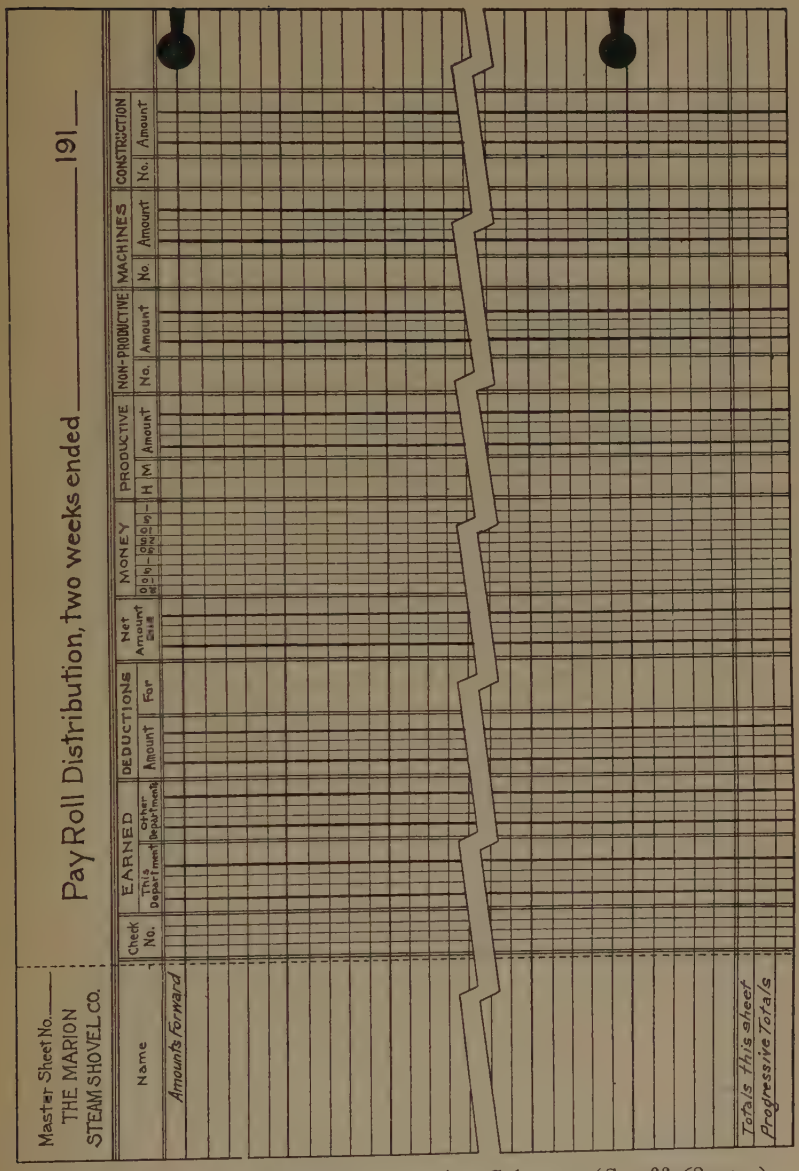


FIG. 132. Pay Roll Form. Segregating Columns, (See §§ 68, 270.) Suggested size, 15"x42 lines.

CHAPTER XL.

FORMS RELATING TO EXPENSE.

§ 317. Comment on Forms of Chapter.*

Figures 133 and 134. Interest Tables—for arriving at cost of carrying product. On this form the value of goods consumed in an entire year is shown in the column at the extreme left of each chart. The figures at the top—for purposes of calculation—represent the number of times during the year that goods might possibly be made up, in order to maintain a sufficient stock on hand. The purpose of the chart is to assist in determining the number of times the goods should be made up for the greatest economy—production cost and interest charges on the investment in these goods being considered. The interest cost of carrying goods when made up but once a year, is shown in the column headed "1." In obtaining the amounts shown in this column, it is supposed that there will be a fairly even use of the goods throughout the year and that therefore the averaged time of carrying the entire investment will be six months.

When the amount of interest on the investment is desired for more than one replenishment during the year, find the rectangle formed by the intersection of the line representing the total value of the yearly production, with the column representing the number of times stock is replenished during the year. Observing the oblique lines passing downward from left to right across the form, select the one which crosses nearest to the upper left-hand corner of the selected

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 318.

rectangle, and follow it with the eye to the amount shown at the right-hand (lower) end of the line. If the oblique line exactly intersects the upper left-hand corner of the selected rectangle, this amount will be the interest desired. If the oblique line intersects the selected rectangle on its left side anywhere below the upper left-hand corner, then a subtraction must be made from the indicated amount; but if the intersection is to the right of the upper left-hand corner, then an addition must be made to it. These calculations may be mentally arrived at by considering the values of the next adjoining base figures and taking a proportionate value between the two.

Figure 135. Curve Sheet—showing point of most profitable production. As quantities increase, production costs usually decrease. If carried too far, however, other factors come into play which gradually diminish the apparent saving from increased production and eventually turn it into a loss. One of the first of these to be considered is interest on the investment in product. Figure 135 illustrates a use of ordinary cross-hatched paper to graphically show the reduction in cost per unit of production as quantity is increased, and to also show the increasing interest on investment as the amount "tied up" in product increases with quantity.

The form is self-explanatory. From the example shown it appears that from the standpoint of these two factors only, a supply of product should be made up sufficient to last two years and a half. This may, however, be much modified by other factors which necessarily enter in. Thus the cost of storage for such a period may be a very material item; patterns may change, or demand fall off, or certain classes of product suffer from deterioration.

The curve sheet may frequently be used to advantage in recording cost variations from other causes than quantity and interest charges, particularly where these are to be presented to those who wish to know the facts but who do not understand nor care to go into the minute detail on which

these variations depend. In such cases, the curve line of a chart brings the desired facts sharply to view, telling the story far more concisely and forcibly than could be done with words.

Figures 136 to 138. Summary of Expense Invoices—with columns for segregating the various classes of items. (See § 94.) The "Total Amount" column of a form of this character is usually made to articulate with a controlling account. (See Part VII.)

Figures 139 and 140. Analysis Sheet for Commercial Costs. (See § 94.) This sheet is in effect a number of small ledger accounts, and is handled practically as a ledger.

Figure 143. Departmental Expense Distribution Sheet—for diffusing expense burden over orders passing or passed through a given department. (§ 94.) The diffusion features of this form are also embodied in Figures 25, 31, 34, 35, 37, and 39.

§ 318. Forms Used in Connection with Expense.

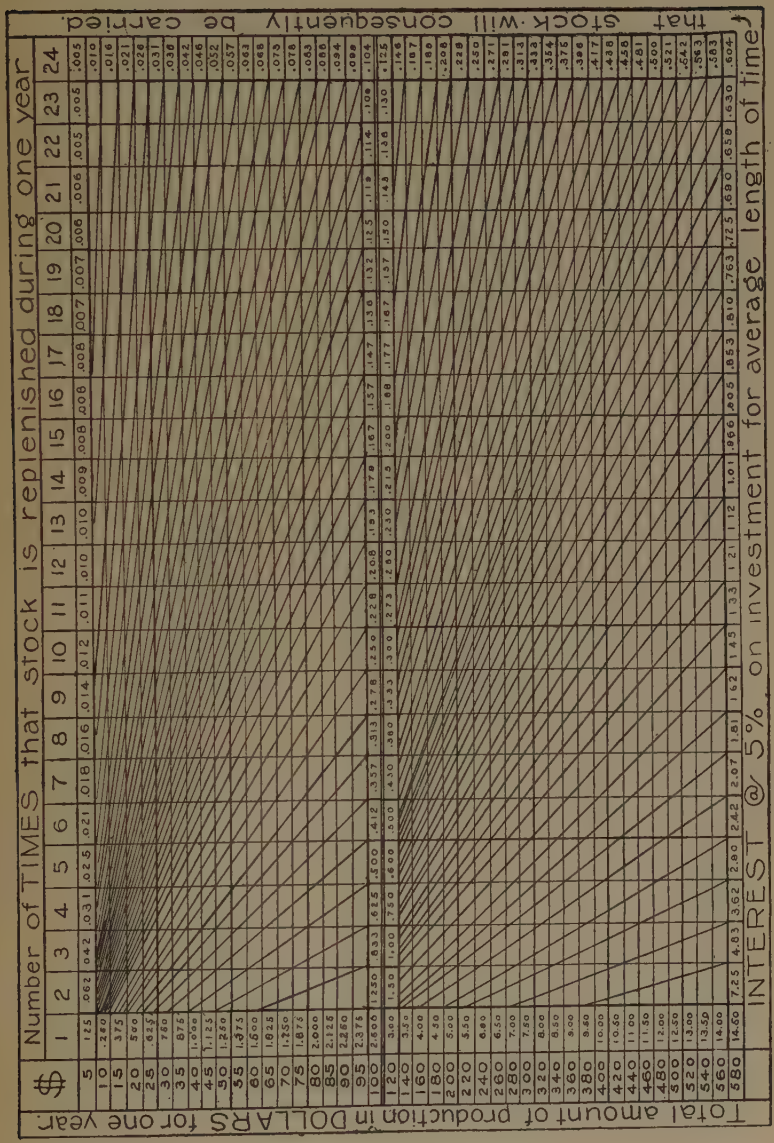

Total amount of production in DOLLARS for one year.
Number of TIMES that stock is replenished during one year
that stock will consequently be carried
INTEREST @ 5% on investment for average length of time

FIG. 133. Interest Calculating Table—$5 to $580. (See § 317.)

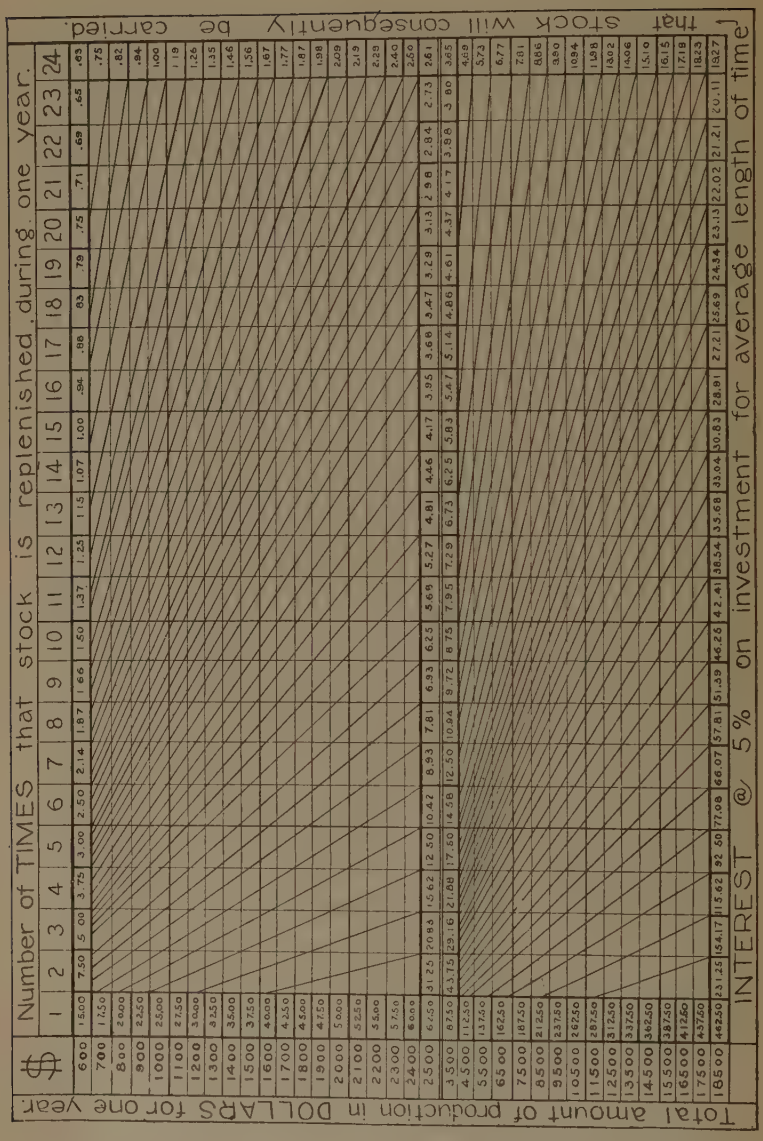


FIG. 134. Interest Calculating Table—$600 to $18,500. (See § 317.)

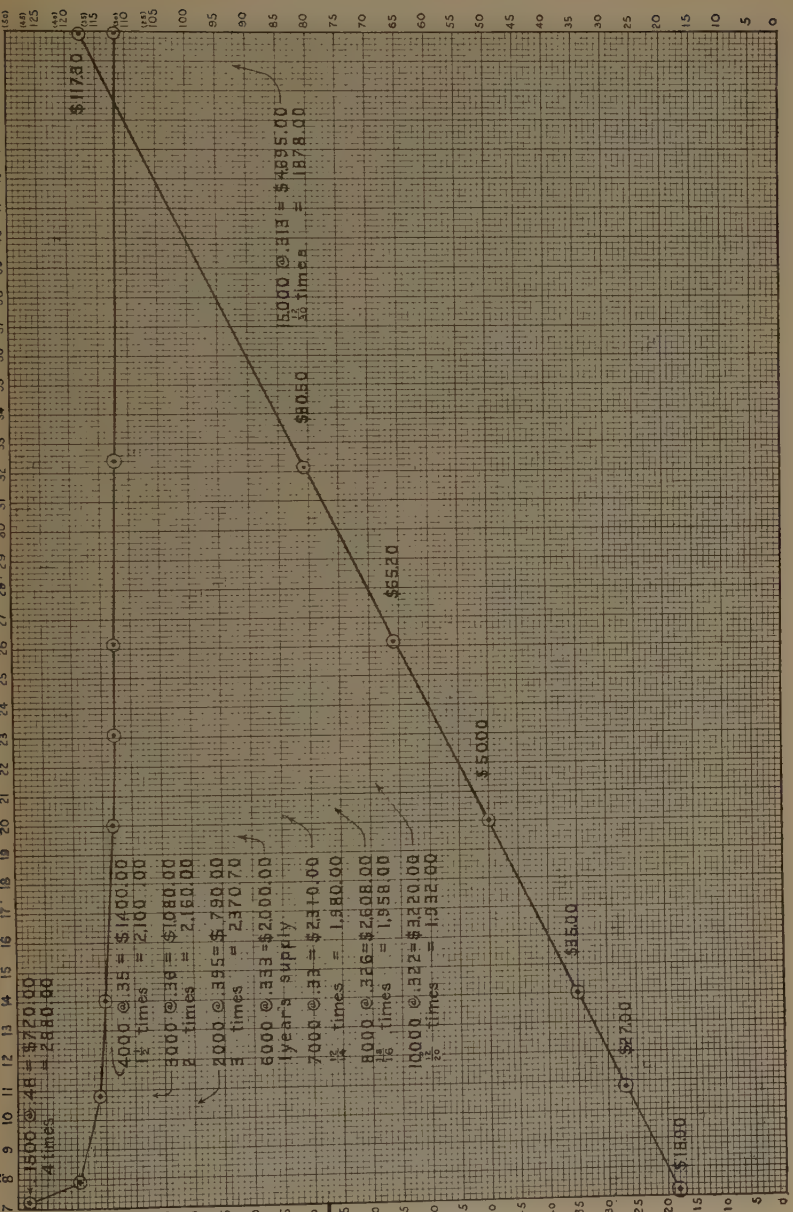
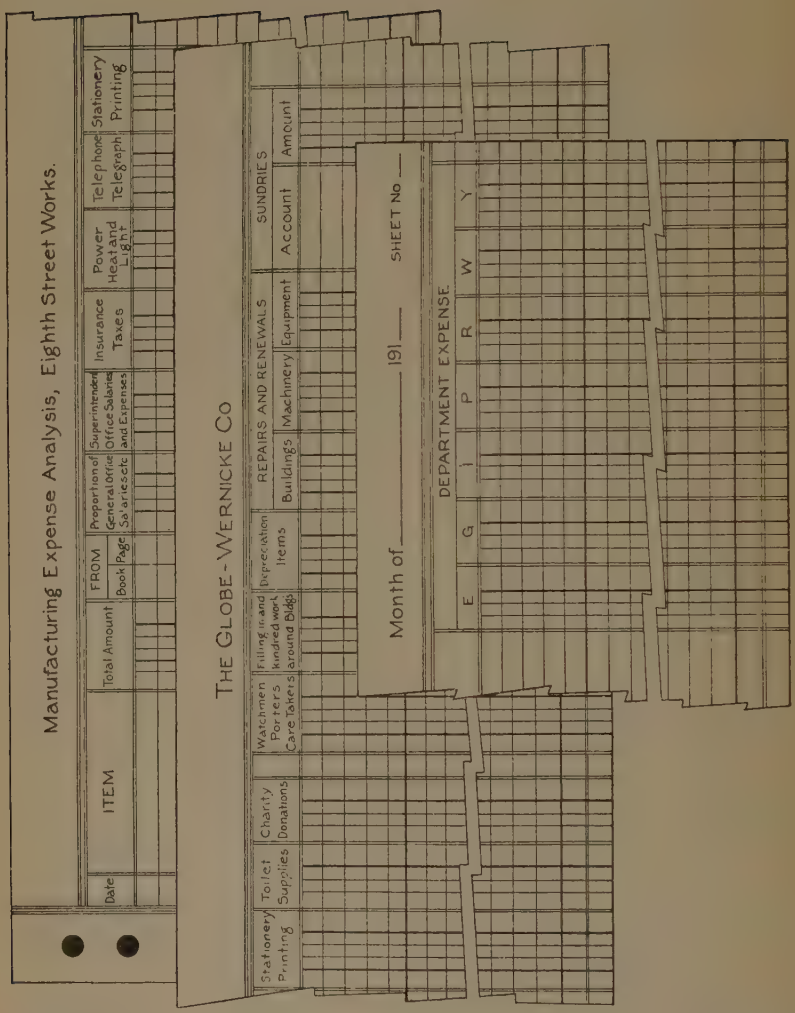


FIG. 135. Production Curve Sheet. (See § 317.)



Figs. 136 (Top), 137 (Middle), 138 (Bottom.) Purchase Invoice Analysis. Sheet. (See §§ 94, 317.) Suggested size, complete form, 25″x51 lines.

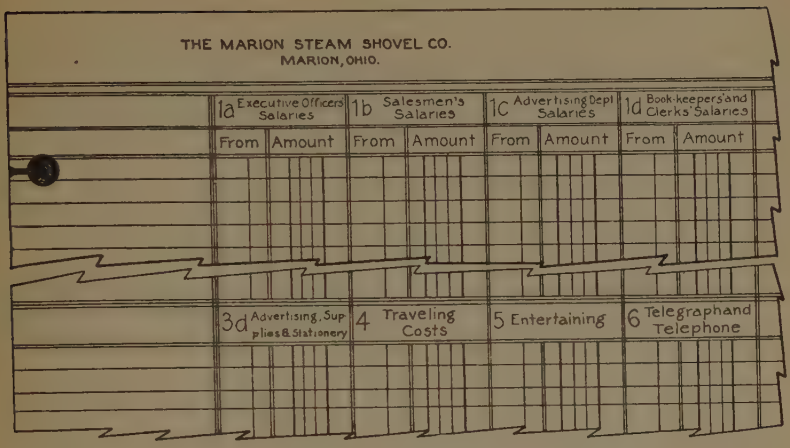


FIG. 139. Analysis Sheet: Commercial Expense—Left Half. (See §§ 94, 317.) See size below.

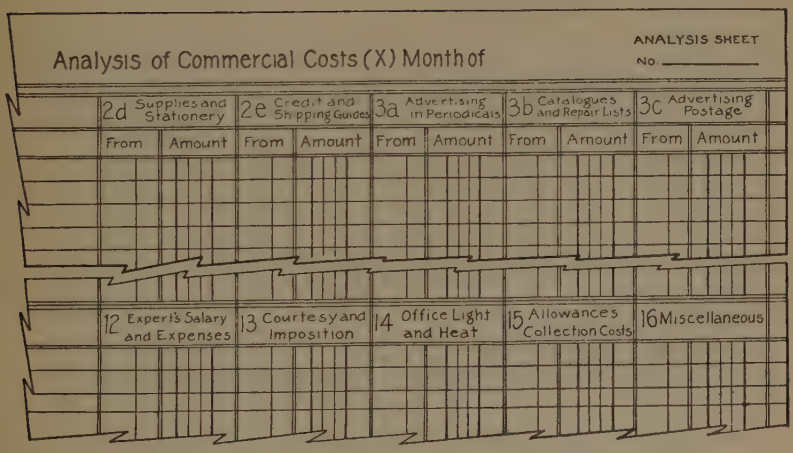


FIG. 140. Analysis Sheet: Commercial Expense—Right Half. Suggested size, complete form, 14″x8½″.

ROCK ISLAND PLOW CO
Rock Island, Ills.

Analysis of Manufacturing Costs, Month of_____ 191__

Foremen			Clerks			Roustabouts			Furnaces			Watchmen			Streets and Ground			Tenement Houses			Repairs to Plant		
Date	from	Amount	Date	from	Amount	Date	from	Amount	Date	from	Amount	Date	from	Amount	Date	from	Amount	Date	from	Amount	Date	from	Amount

Repairs to Machinery	Repairs to Small Tools	Repairs to Sprinkler Plant	Repairs to Transmission	Repairs to Tracks & Cars	Experimental	Warehousing	Stable

Taxes	Insurance	Heat	Light	Water	Oil and Waste	Cleaning and Sweeping	Unloading Stock

FIG. 141. Analysis Sheet. Manufacturing Expense. (See §§ 94, 210.) Suggested size, 14"x8½".

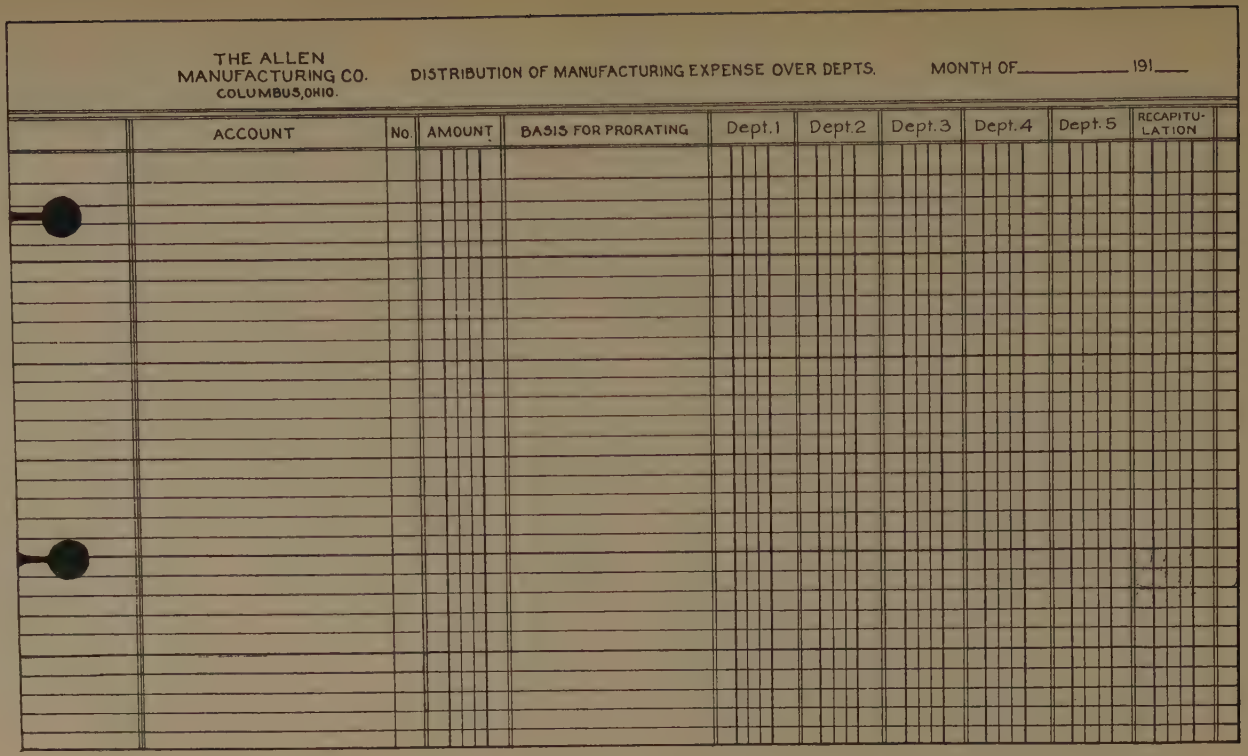
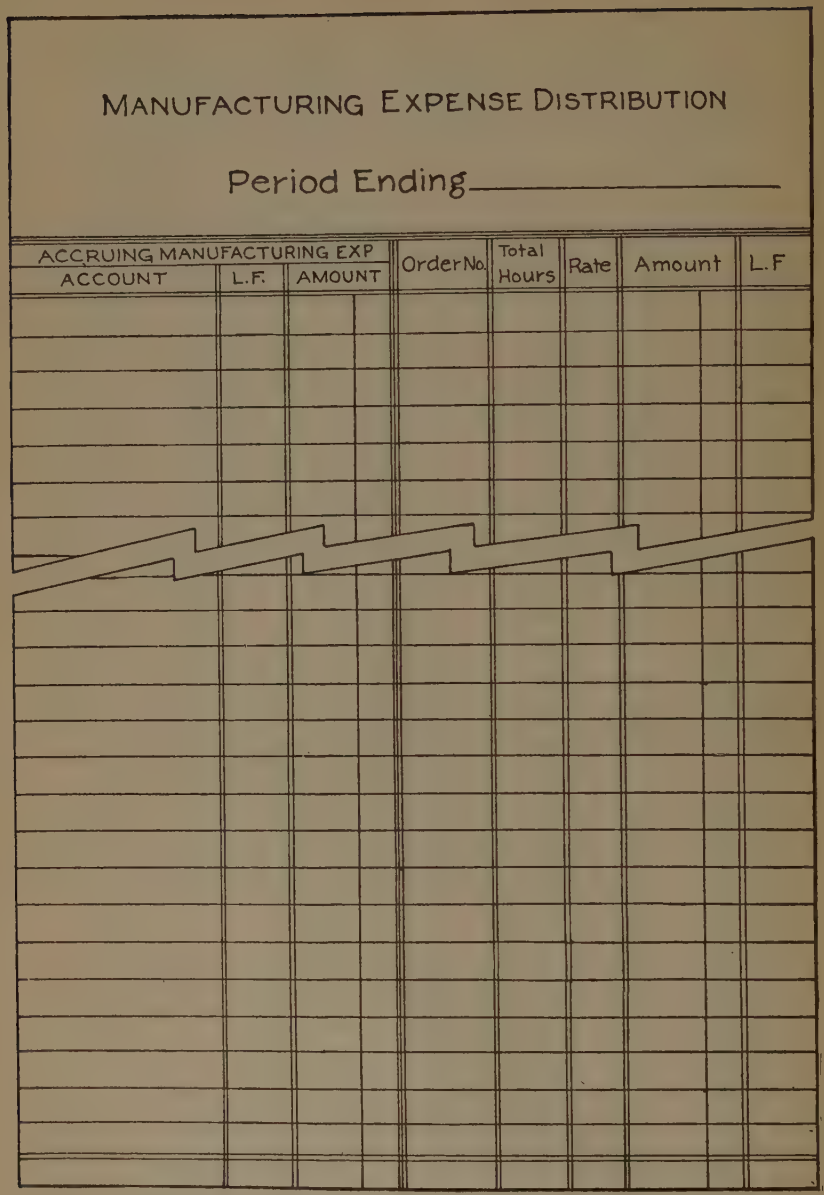


FIG. 142. Expense Segregating Sheet. Over Departments. (See §§ 94, 161.) Suggested size, 14″x8½″.


MANUFACTURING EXPENSE DISTRIBUTION

Period Ending_____

ACCRUING MANUFACTURING EXP ACCOUNT	L.F.	AMOUNT	Order No.	Total Hours	Rate	Amount	L.F

Fig. 143. Expense Diffusion Sheet. Over Orders. (See §§ 94, 317.) Suggested size, 5½"x12".

CHAPTER XLI.

REPORTS.

§ 319. Comment on Forms of Chapter.*

Figure 145. Steel Castings Report—by heat numbers. This form is usually made out by the cleaning-room foreman or his clerk. In the column headed "Class" the castings are classified in accordance with the table appearing in the upper left-hand portion of the form. When, in the cleaning room, castings are found to be worthless, they are entered by casting number—the weight being shown under the "Scrap" column—so that all product may be properly accounted for in other records.

Figure 146. Iron Foundry Castings Report. This form is employed to report castings made. Its headings show clearly the manner of its use. It will be noted that it provides for a full report of any castings which have been reported out as good, but which later are found defective and are returned or rejected.

Figure 147. Iron Foundry Flask Card—showing castings poured. This form is made out by the moulder and shows the pattern number of everything included in the flask; also the length of time spent on the single casting or the group as the case may be. This form remains attached to the flask—tacked on wooden flasks, or held in a special container if the flask be of metal. When the flask is poured, the card is lifted and turned into the foundry office as a positive record of the castings poured.

Figure 148. Defective Castings Ticket. This is a sim-

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 320.

ple form for turning back rejected castings, either before or after such castings have left the foundry.

Figure 150. Daily Report of Building Construction. On the left-hand side of this form the superintendent or his clerk records any material received on the "job" so that the invoices may be promptly and properly checked for payment. The right-hand side provides for a report on the progress of the work, together with the material and labor cost of same.

§ 320. Forms of Reports.

ORIGINAL

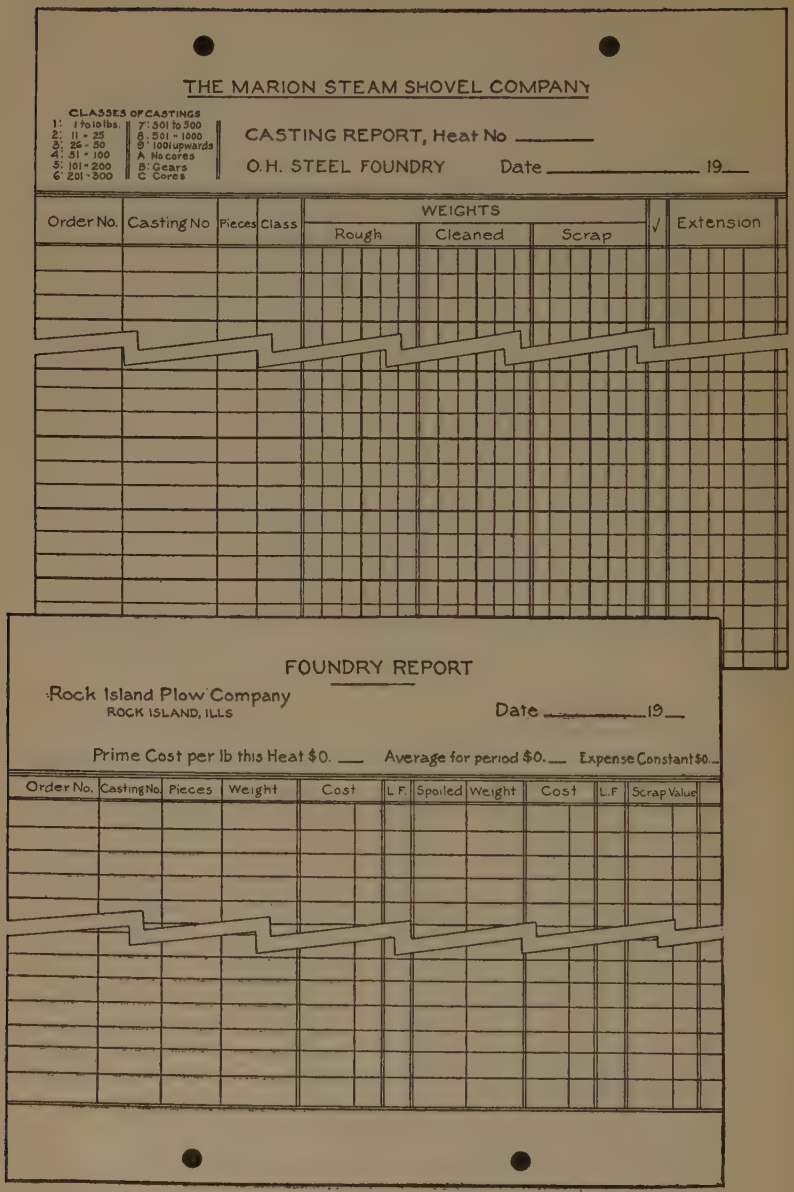
THE HINDE & DAUCH PAPER CO.

PAPER MADE AT _____ MILL _____ 19__

REELS	ROLLS SIZE AND WEIGHT	TOTAL WEIGHT	KIND	THICK-NESS	WEIGHT RUN	WEIGHT DRY	MOISTURE PER CENT	REMARKS
TOTAL MADE THIS DAY			AVERAGE PER CENT MOISTURE					

_____ MACH. TENDER _____ RUN

FIG. 144. Paper Mill Report. Mass Product. Suggested size, 7"x8".


THE MARION STEAM SHOVEL COMPANY

CLASSES OF CASTINGS
1: 1 to 10 lbs
2: 11 - 25
3: 26 - 50
4: 51 - 100
5: 101 - 200
6: 201 - 300
7: 301 to 500
8: 501 - 1000
9: 1001 upwards
A No cores
B Gears
C Cores

CASTING REPORT, Heat No _____

O.H. STEEL FOUNDRY Date _____ 19__

Order No.	Casting No	Pieces	Class	WEIGHTS Rough	Cleaned	Scrap	√	Extension

FOUNDRY REPORT

Rock Island Plow Company
ROCK ISLAND, ILLS

Date _____ 19__

Prime Cost per lb this Heat $0. ___ Average for period $0. ___ Expense Constant $0. ___

Order No.	Casting No.	Pieces	Weight	Cost	L.F.	Spoiled	Weight	Cost	L.F	Scrap Value

FIG. 145 (Upper). Steel Castings Made. (See § 319.)
Suggested size, 8"x12".

FIG. 146 (Lower). Gray Iron Castings Made. (See § 319.)
Suggested size, 8"x12".

FOUNDRY FLASK CARD.

Moulder's Name _____ No. _____

Time Began _____ Time Finished _____

No. Made	Casting No.	Remarks	Leave this blank		

N.B.– When casting is poured this card must be taken up and taken to office

FIG. 147. Foundry Flask Card. (See § 319.) Suggested size, 4½"x2¾".

DEFECTIVE CASTING TICKET	QUANTITY	PATTERN NO	ORDER NO.
PART			
DEFECTS			
STATE OF COMPLETION			
DATE		APPROVED BY	

FIG. 148. Defective Castings Ticket. (See § 319.) Suggested size, 5"x3".

THE MARION STEAM SHOVEL COMPANY REPORT OF DEFECTIVE WORK

IDENTIFICATION

Name of Part _____ Casting No. _____

Workman No. _____ Department No. _____ Order No. _____ Foreman

CAUSE			
1 Imperfect Material	5 Improperly cored	9 Other causes	Defective through cause No _____
2 Imperfect Part	6 Improperly laid off		Fault of Department _____
3 Broken	7 Spoiled in Machining		Can goods be used elsewhere _____
4 Blow Holes	8 Bad Pattern		Where? _____

DISPOSITION OF THE GOODS

Delivered to _____ Date _____ For what use? _____

In the Cost Department the Order Number to which Material, Labor, etc. have been charged, will be given credit as per amounts shown

Finished Parts	Cr. $	Scrap Account	Dr. $
Material	Cr. $	Expense	Dr $
Machine Time	Cr. $	O.S.& Damage	Dr $
Labor	Cr. $		
Expense	Cr. $	Entered by _____	Dr _____ Cr.

THE MARION STEAM SHOVEL COMPANY REPORT OF DEFECTIVE WORK

IDENTIFICATION

Name of Part _____ Casting No. _____

Workman No. _____ Department No. _____ Order No. _____ Foreman

FULL EXPLANATION OF CAUSE

Fig 149. Defective Work Report. (See §§ 54, 153, 268.)
Suggested size, 7"x6¾".

D.W McGRATH, BUILDING CONTRACTOR.

Daily Report of Goods Received and Progress made on _____ Job

Date _____ 191__

Entries

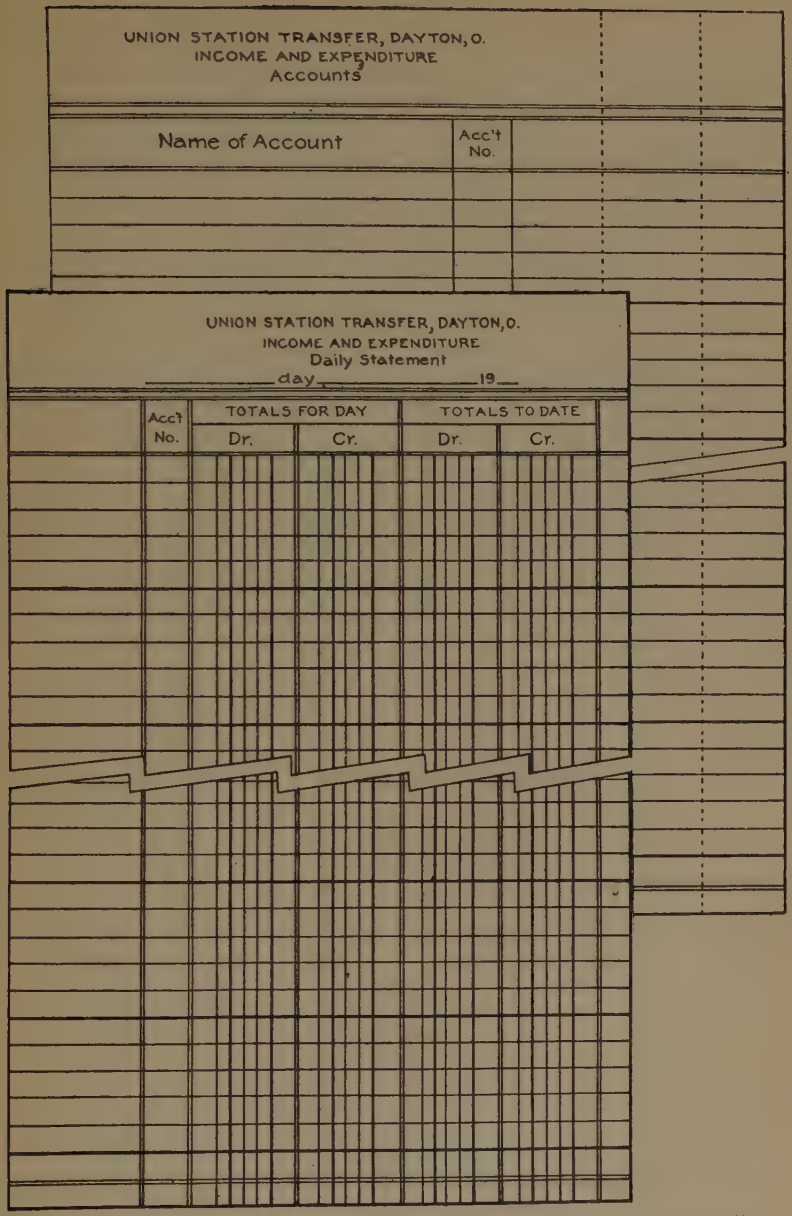
	QUANTITY	COMMODITY	RECEIVED FROM	CAR No	WORK DONE	QUANTITY		LABOR COST	MATERIAL COST
					Brick Laying	Brick			
					Excavating	Yards			
					Concrete	Yards			
					Stone	Perch			
					Iron Erecting	Tons			
					Plastering	Yards			
					Fire Proofing	Sq. Ft.			
					Cinder Concrete				
					Terra Cotta Set				
					Totals				

FIG. 150. Daily Report for Building Construction. (See § 319.) Suggested size, 11"x6".

FINISHED PARTS

In Process											Finished									
Period No.	Finished Parts	Raw Material	LABOR Hours	LABOR Cost	Direct Expense	Diffused Expense	Total Cost for Period	Entered	Period No.	Finished Parts	Raw Material	LABOR Hours	LABOR Cost	Direct Expense	Diffused Expense	Total Cost for Period	Entered
1								Folio	1								Folio
2								"	2								"
3								"	3								"
4								"	4								"
5								"	5								"
6								"	6								"
7								"	7								"
8								"	8								"
9								"	9								"
10								"	10								"
11									11								
12									12								
13									13								
GRAND TOTALS									GRAND TOTALS								
	Finished Parts	Raw Material	Hours	Cost	Direct Expense	Diffused Expense	Grand Total Cost			Finished Parts	Raw Material	Hours	Cost	Direct Expense	Diffused Expense	Grand Total Cost	

FIG. 151. Periodical Summary of Production. Open Order. Suggested size, 12"x6".



FIGS. 152 (Upper), 153 (Lower). Daily Financial Report. Master Sheet and Slip Sheet. (See § 297.) Suggested sizes, upper, 7″x12″; lower, 6″x12″.

Month Ending _____ 191__

ASSETS:–	FACTORY SALES:–
Cash	This month
Bills and Accounts Receivable	Same month last year
Investments	Fiscal year to date
Branches	same period last year
Factory Properties	BRANCH SALES:–
Factory Merchandise	This month
Goods in Process	Same month last year
Raw Material	Fiscal year to date
Patents	Same period last year
Common Stock Subscription	GENERAL EXPENSE & FIXED CHARGES
Loss to date	This month
	Same month last year
	Fiscal year to date
	Same period last year
LIABILITIES	NET EARNINGS:–
Bills and Accounts Payable	This month
Bonds	Same month last year
Preferred Stock	Fiscal year to date
Common Stock	Same period last year
Surplus	% GENERAL EXPENSE, Etc. TO SALES:-
Earnings to date	This month
	Same month last year
	Fiscal year to date
	Same period last year

FIG. 154. Monthly Financial Report. (See § 299.) Suggested size, 8½"x11".

THE MARION STEAM SHOVEL CO.
ENGINEER'S REPORT Date _____ 19__

	332 Corliss	753 Gas	186 Buckeye	307 Ball	308 Blast	754 Ingersoll	564 McKinnon
Power Started							
Power Stopped							
Hours Run							
Average H.P. per Hour							

Remarks

Engineer

FIG. 155. Power Consumption Report. (See § 139.) Suggested size, 6"x4".

CHAPTER XLII.

FORMS FOR RECORDING COSTS.

§ 321. Comment on Forms of Chapter.*

Figures 159 to 161. Detailed Cost Record—by elements and integrants. The first page of this record is descriptive the second page details by departments; and the third page summarizes by cost elements. (See §§ 228, 230.) Records of this character are usually made up for articles of product which are more or less standard. The record for a given article often spreads over a number of sheets. These are permanently fastened together, and the whole becomes an analyzed and summarized production cost record of the article—a valuable document when properly filled out. Labor costs may be entered on this record from a form similar to that shown in Figures 182 and 183.

Figures 162 to 164. Specification and Cost Sheet. The first page of this form is descriptive and is also a record of material costs; the second page is a record of labor costs and of burden; and the third page summarizes under dates and by elements. This form resembles the preceding form in some of its features. There is a material difference, however, in the fact that the present form ignores specific operations and treats altogether with the physical production elements for the department or the plant as a whole. Data from material and labor cards can be posted direct to this form, which is not the case with the preceding form—save as to entries from forms similar to that shown in Figure 182—as it is a summary of

*Comment is made here only when the form is not commented on fully in the text of the volume. Text references will be found immediately following the title of each form in § 322.

costs taken from other cost collating records. The present form presents totals or summaries as of different dates (in the case of indeterminate orders) while the preceding form gives its summaries as of one date only.

Figures 165 to 168. Summary of Costs by Operations—irrespective of departments. This form can be used in connection with Figures 169 and 170.

Figures 169 and 170. Comparison of Costs (obverse and reverse)—comparison by operations and summary by departments. (See § 277.) Summarized costs can be taken from Figures 165 to 168 for use on this comparison sheet.

Figures 176 and 177. Process Cost Summary. Used when the same operation is applied to physically different shapes or parts on a unit basis. Figure 177—reverse of Figure 176—is a record of material or parts worked on. The posting references in this form correspond with those of Figure 162 so far as material is concerned.

Figure 178. Machine-Time Summary. Four-week record of preparation, idle and active time, and production of individual machines in an industrial center. Cost applied to production on a machine-hour basis. (See §§ 238, 274.)

Two columns might be added to the left side of this form for showing respectively the loom (or machine) number and the number of the week. As the form is shown, the week numbers and the loom (or machine) numbers are in each case supposedly to be written or stamped just to the left of the triple line in the zones or lines prepared for footings.

Figure 179. Machine-Time Record—by days for one month. Shows preparation, idle and active time and production of individual machines in an industrial center. Cost applied to production on a machine-hour basis. (See §§ 216, 238, 243, 275.)

Figures 182 and 183. Specific Job Cost Collating Record—standard product. (See § 277.) This form represents a second card under the same "part," to show the operation

of the plan when there are a large number of integrants. Thus, if there were twenty-nine integrants to the part, the pieces, or integrants numbers 1 to 16 inclusive would appear on the first card, and numbers 17 to 28 inclusive on the second card of the present form. The totals from this record are summarized on a form similar to that shown in Figure 160 or 163.

Figure 184 and 185. Process Cost—applied to orders of indeterminate quantity. The reverse of the sheet shows the material requirements and a check system for issuances of this material from store-rooms. (See § 277.) As an example of the material checking feature, it may be supposed that integrant No. 9 is a three-inch brace, and that two of these are required for one unit of product. The figure 2 will then be shown in the upper rulings of the form, opposite No. 9. If fifty of such braces are drawn from the stock-room, this is indicated by the number 25 entered in column headed "9"; indicating that a sufficient number of the integrants designated by 9 have been issued for 25 units.

Figure 186. Weight Cost Summary. This form is used for determining the net labor and expense cost per pound of finished product. The plan is somewhat antiquated though it is still adhered to by some manufacturers of machinery, vehicles, etc., even where modern cost-finding methods are employed. There are products, as castings, springs, axles, which are sold on a pound basis and are, therefore, properly calculated as to cost on a pound basis. Figure 168 also embodies this same pound-cost feature.

Figure 193. Daily Report—Steel Foundry. This form covers all details but deals in weights only, such weights to be later entered on a form similar to that shown in Figure 195 but so arranged as to conform to open hearth steel requirements.

Figure 194. Report—Blast Furnace—details for twenty-four hours. The totals from this form are summarized

to advantage on a form similar to that shown in Figures 195 to 198.

Figures 195 to 198. Report—Blast Furnace. This form gives a summary of details by days. A form of this character can be advantageously used in connection with the cupola reports of Figures 192 and 193.

Figure 199. Summary of Costs—by production elements, departmentally. (See §§ 224, 228, 229, 232.) This and the form shown in Figure 200 are particularly applicable to the list-percentage plan.

Figures 200 and 201. Comparative Records. (See §§ 155, 230.) Labor comparisons, other than those presented in this chapter, may be found in Figures 165 to 172, 182 and 183.

Figure 202. Office Copy of Factory Schedule. This form is used as a basis for resolving a cost per pound into a cost per unit, and thereafter making a factory ledger entry, based on such calculation. (See §§ 223, 225.)

§ 322. **Cost Recording Forms.**

ORDERED FINISHED

Job No. | Shop Order No. | Symbol

No. Pieces | Name of Piece

Labor			Material		
Hours	Rate	Amounts	Quantity	Price	Amounts
				Direct Expense	
	Hrs. Total			Total Material	
				Total Labor	
				Net Cost	
Burden ___ cts. per hour				Burden	
Piece Cost, Net ___				Gross Cost	
Piece Cost, Gross ___					

FIG. 156. Summary for Cost Cards. Envelope Form. (See § 270.) Size to fit cards.

THE MARION STEAM SHOVEL CO.

MEMORANDUM OF TRANSFER
of Labor and Material Costs, between Orders in Process or other accounts

Dept. No. _____ Date _____ 19__

Charge _____ Order No. _____

Credit _____ Order No. _____

Explanation _____

_____

_____

_____

_____

_____

_____

_____

IF OTHER ACCOUNTS THAN GOODS IN PROCESS

Charge Account No. _____

Credit Account No. _____

Requested by _____

Entered in Order Register _____

FIG. 157. Transfer of Costs. (See §§ 55, 276.) Suggested size, 3⅜"x7".

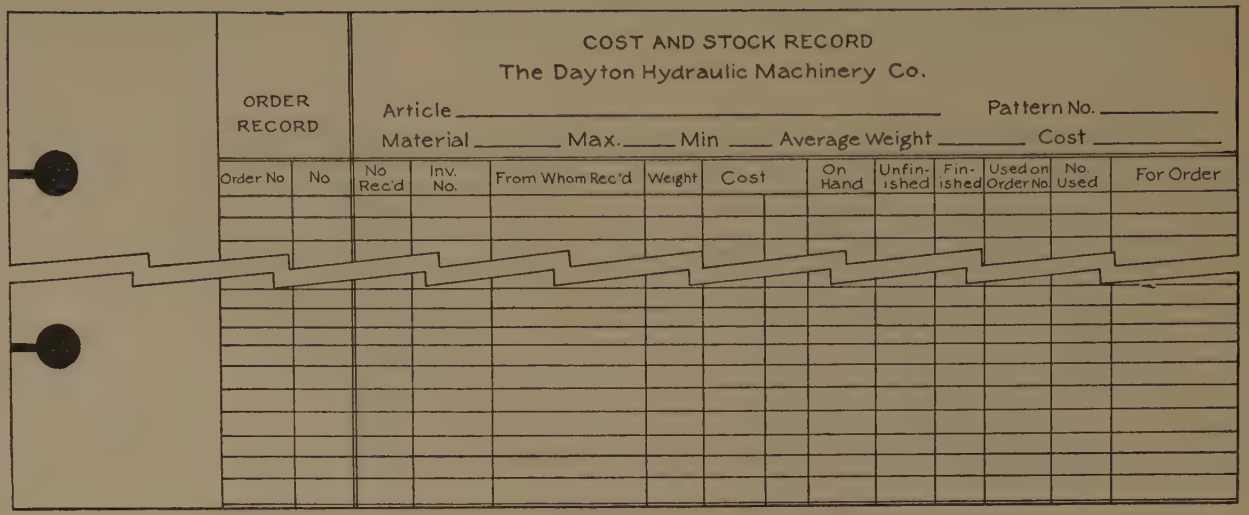


FIG. 158. Cost Record. Machinery Parts. Suggested size, 11"x8½".

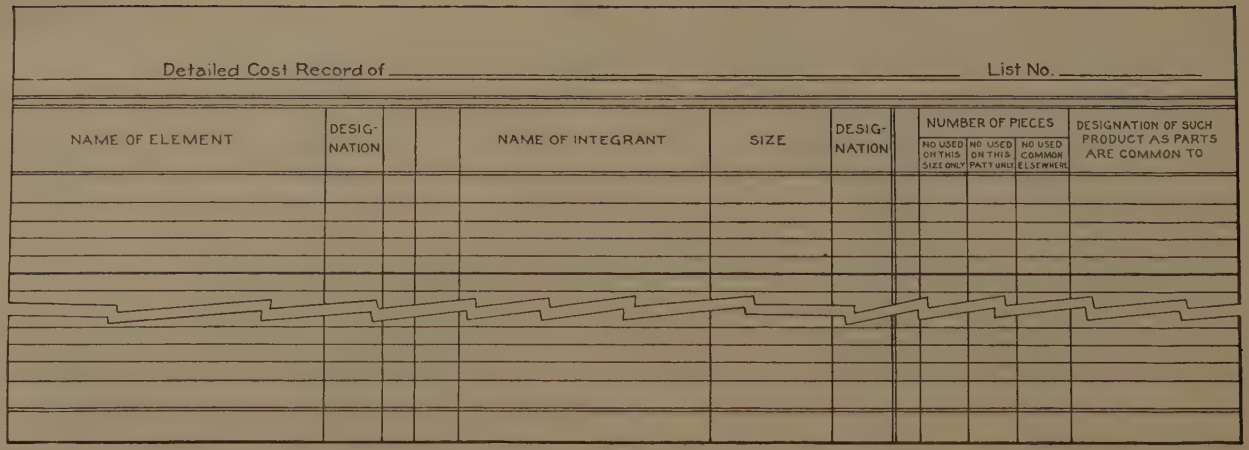


FIG. 159. Detailed Cost Record—First Page. (See §§ 228, 321.) Suggested size, 14"x17".

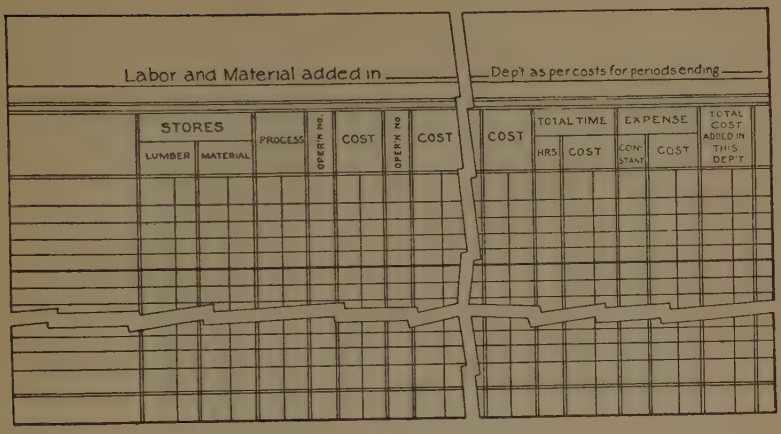


FIG. 160. Detailed Cost Record—Second Page. See size below.

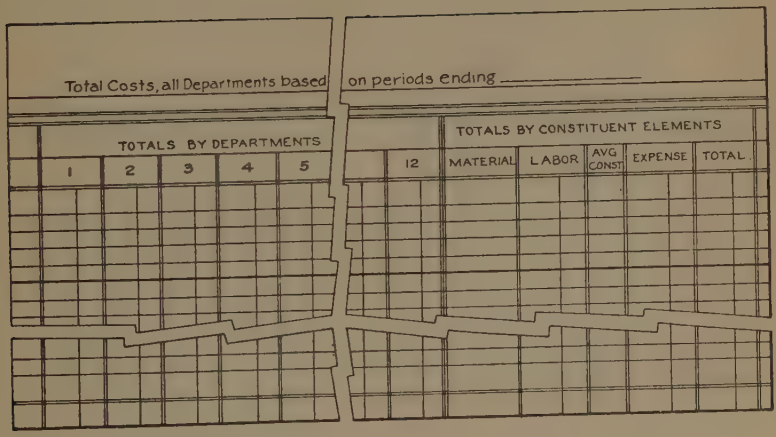


FIG. 161. Detailed Cost Record—Third Page. Suggested size, 14″x17″.

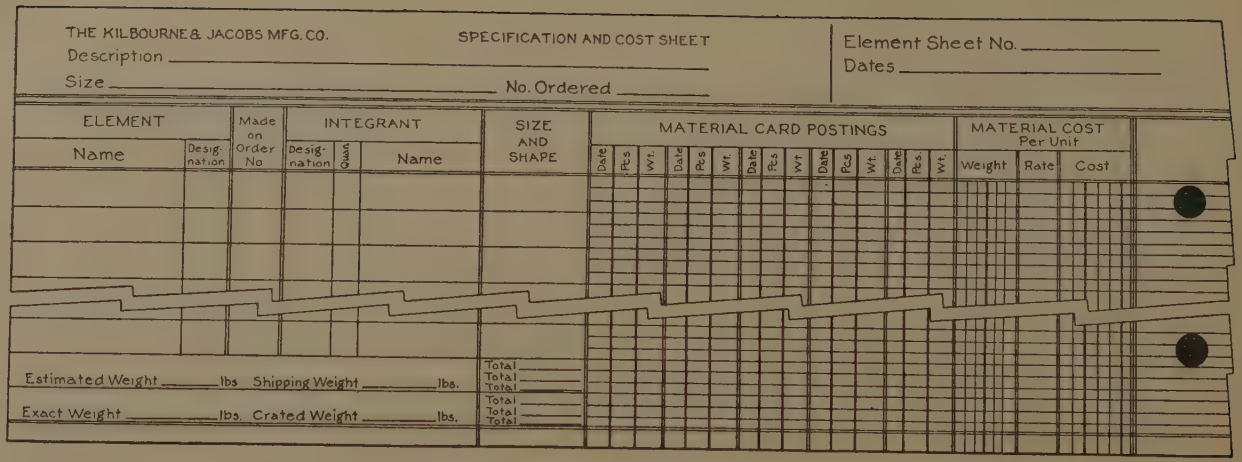
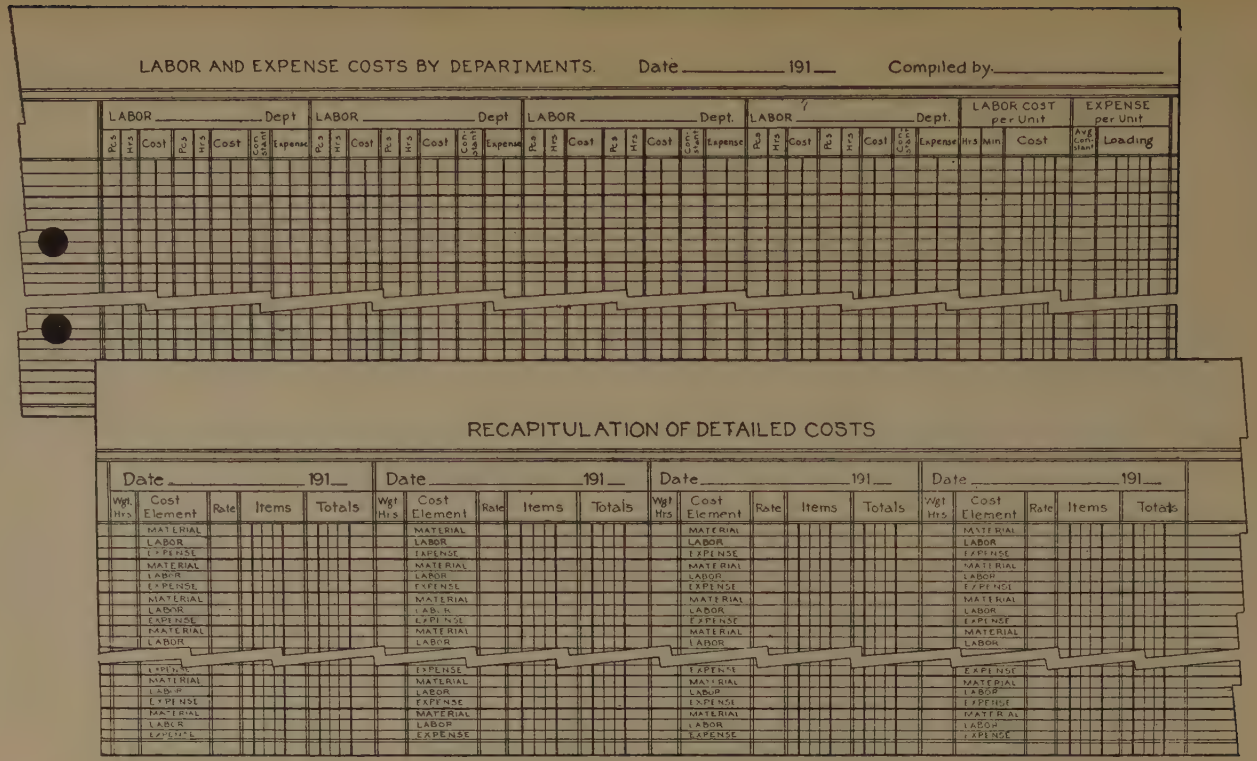
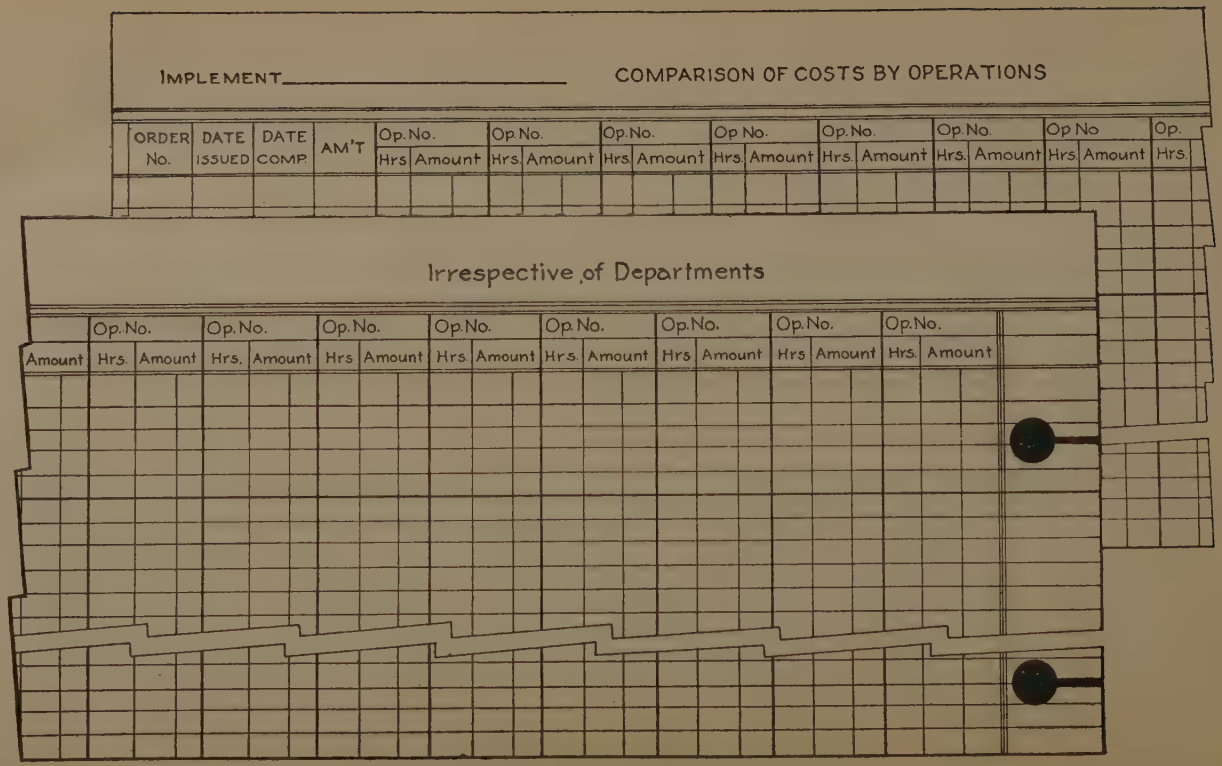


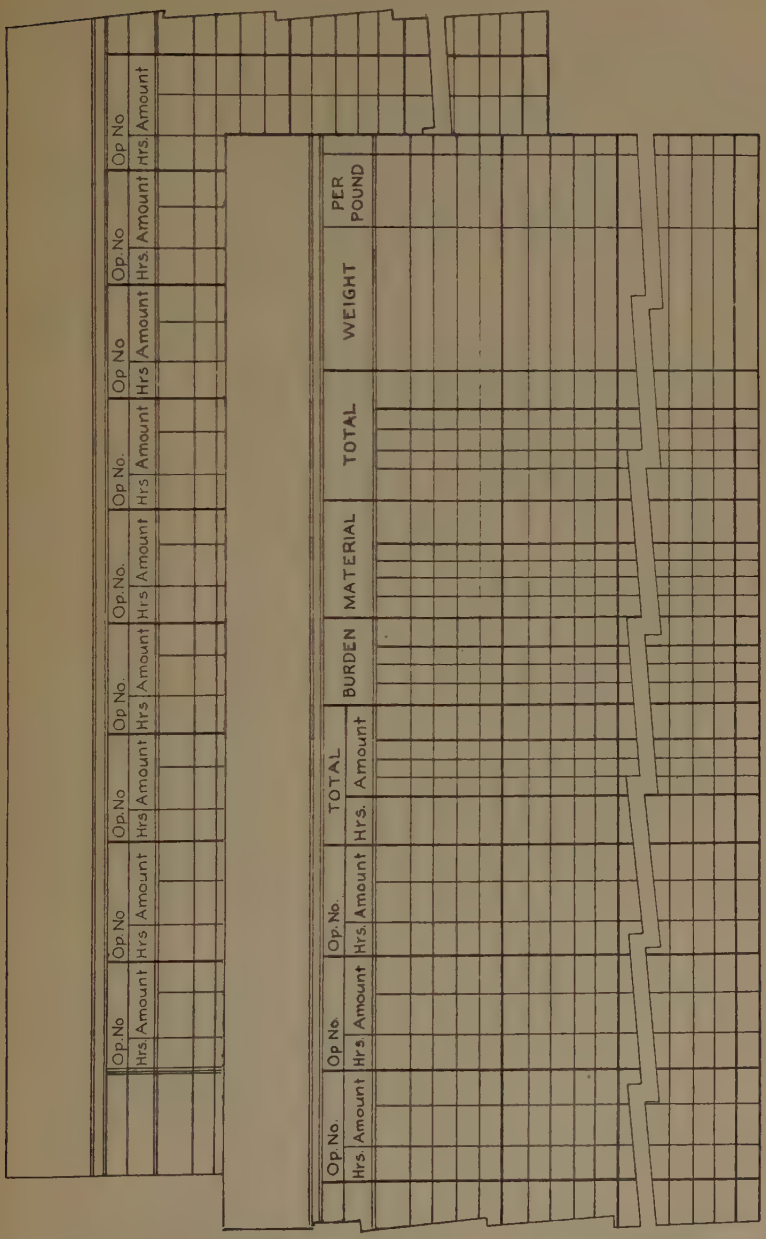
FIG. 162. Specification and Cost Sheet—First Page. (See § 321.) Suggested size, 14"x17".



FIGS. 163 (Upper), 164 (Lower). Specification and Cost Sheet—Second and Third Pages.
Suggested size for each, 14″x17″.



FIGS. 165 (Upper), 166 (Lower). Summary of Costs by Operations—Face of Page. (See §§ 277, 321.) Suggested size, complete form, 18"x17".



FIGS. 167 (Upper), 168 (Lower). Summary of Costs by Operations—Reverse of Page. Suggested size, complete form, 18"x17".

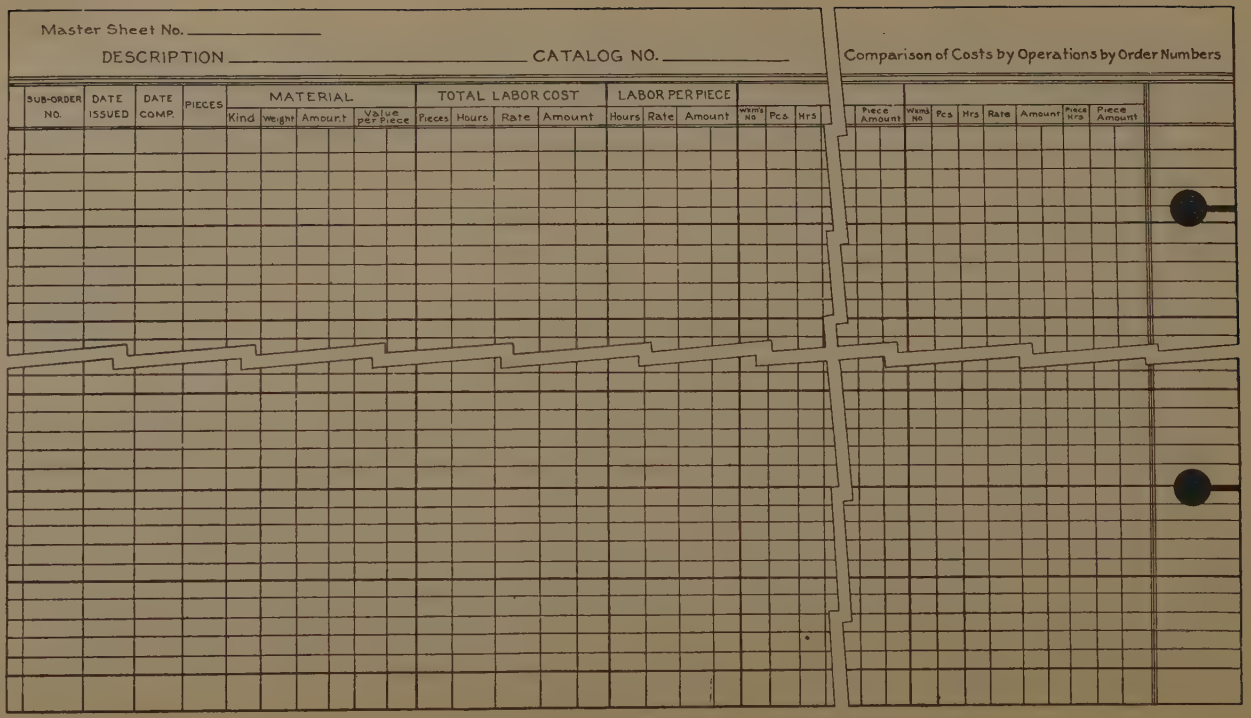


FIG. 169. Comparison of Costs—Face of Page. (By Operations.)
(See §§ 277, 321.) Suggested size, 18"x17".

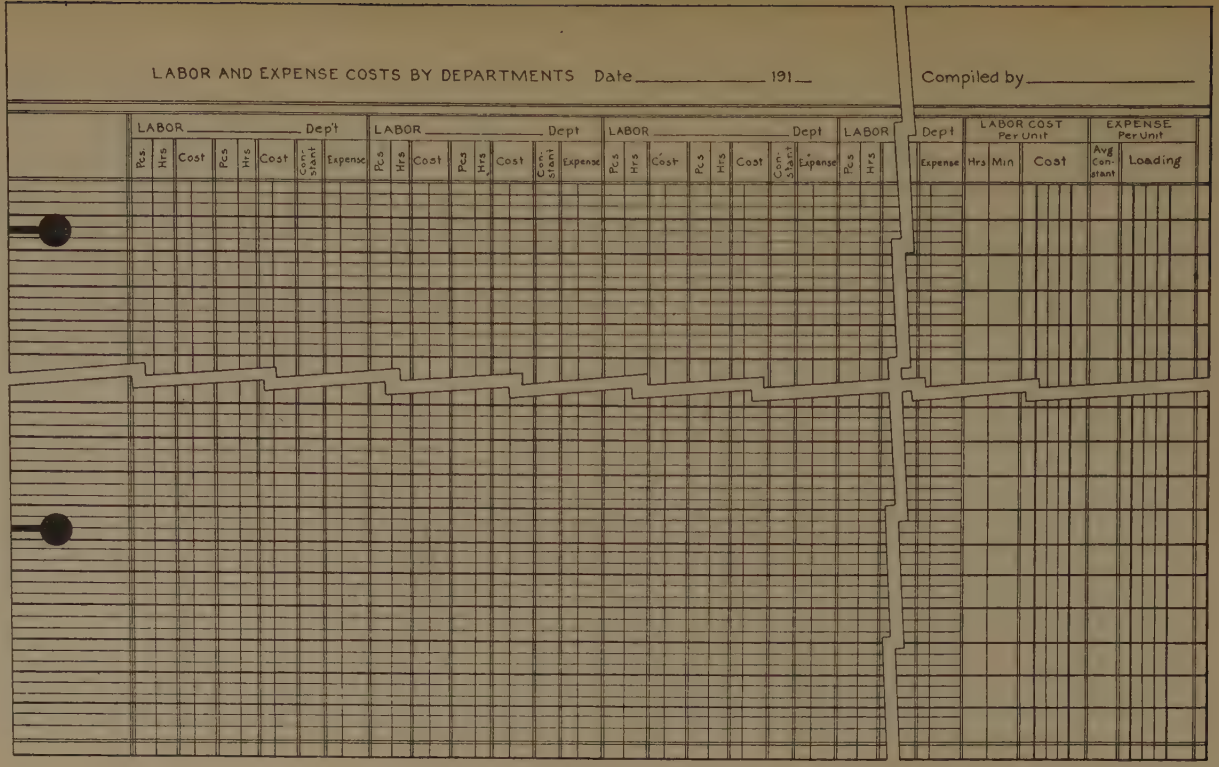
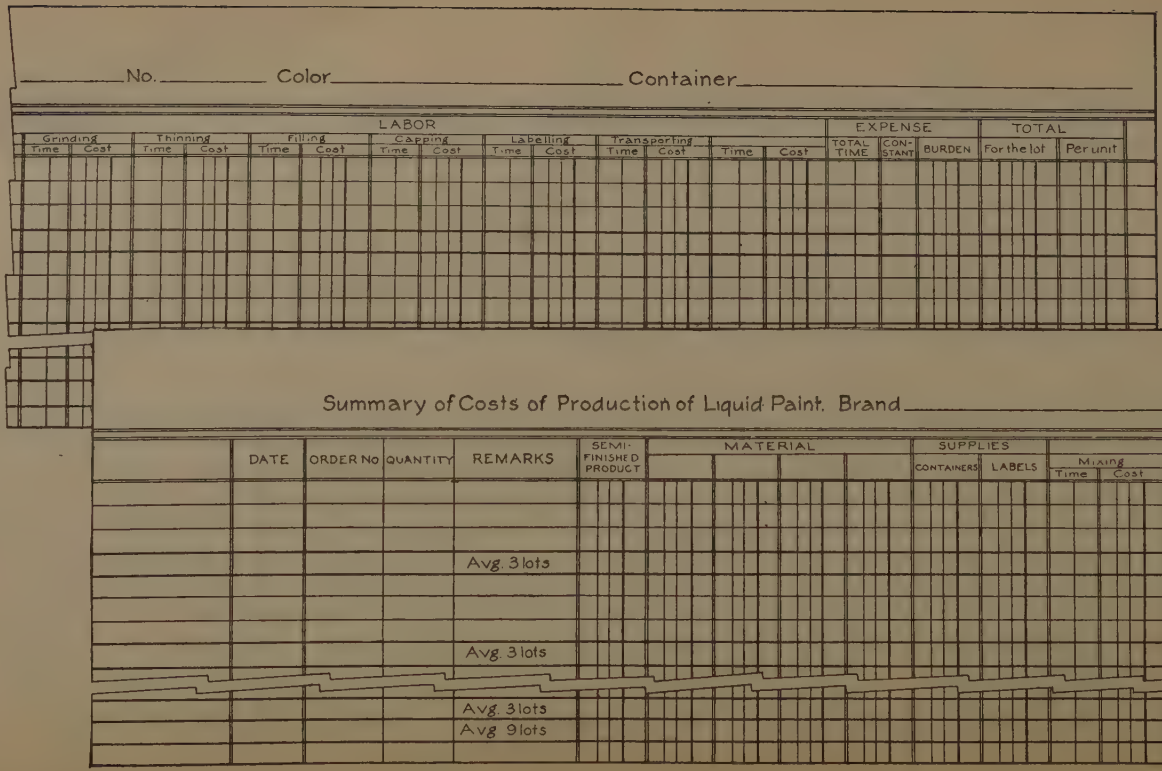


FIG. 170. Comparison of Costs—Reverse of Page. (By Departments.) Suggested size, 18"x17".



FIGS. 171 (Lower), 172 (Upper). Comparison of Costs. (Face of page, by operations; reverse, by departments.) (See §§ 229, 232.) Suggested size, 24″x18″.

VANBROCKLIN KNITTING CO.
AMSTERDAM, N.Y.

PRODUCTION SUMMARY AN

WASHING AND DYEING DEPARTMENT
Cost Period No. Ended 191_

Report No.	1 BALMESH		2 ILETMESH		3 INTER-LOCK		4 COLLAR	
	Pounds Unfinished	Yards Finished	Pounds Unfinished	Yards Finished	Pounds Unfinished	Yards Finished	Pounds Unfinished	Yard Finish

SUMMARY OF DEPARTMENT COSTS			
Item	Page	Cost	Per Yard
Labor			
Power Cost			
Overhead Quota			
Soap, Soda, etc.			
Dye Stuff			
Chemicals			
Sundries			
Total Cost			

NET PRODUCTION COST				
UNFINISHED		FINISHED CLOTH COST		
Cloth No.	Value	Value	Yards	Per Yard
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Totals				

FIG. 173. Process Cost Summary. Single Cost. Suggested size, 14"x8½".

YARN MILLS, Div. No.__ Summary of Production Costs, Period No.__ Year 191__

Elements	PRODUCTION Pounds	PRODUCTION Cost	COST PER POUND This Period	COST PER POUND Av. 3 Periods	Elements	PRODUCTION Pounds	PRODUCTION Cost	COST PER POUND This Period	COST PER POUND Av. 3 Periods
COMBING WOOL					SPINNING YARN				
Raw Wool opened					Company Tops				
Sorting					Purchased Tops				
Opening and dusting					Gill Boxes				
Scouring					2 Spindle Gill				
Drying					4 " " "				
Picking and Mixing					8 " Drawing Frame				
Conditioning					Dandy Rover				
Carding					Spinning Yarn				
Gilling					Redoubling Yarn				
Combing					Reeling Yarn				
Balling Tops									
Totals					*Totals*				
Noils					Hard Waste				
Comb Waste					Soft Waste				
Card "					Fly				
Picker "					Sweepings				
Burr "									
Material Net					*Material Net*				
Total Labor					*Total Labor*				
Total Expense					*Total Expense*				
White produced					*White Yarn in grease*				
Britch "					*Light Grey " "*				
Black "					*Dark " " "*				

Fig. 174. Process Cost Summary. Various Operations. Suggested size, 14" x 8½".

FABRIC DEPARTMENTS, Div. No.__ Summary of Production Costs, Period No.__ Year 191__

Elements	PRODUCTION Yards	PRODUCTION Cost	COST PER YARD This Period	COST PER YARD Av. 3 Periods
WEAVING				
Oneida $\frac{5}{8}$ Material				
" $\frac{3}{4}$ "				
Amsterdam $\frac{5}{8}$ "				
" $\frac{3}{4}$ "				
Imperial $\frac{5}{8}$ "				
Shuttleworth $\frac{5}{8}$ "				
" $\frac{3}{4}$ "				
French Wilton $\frac{3}{4}$ "				
Kilmarnock $\frac{3}{4}$ "				
" $\frac{5}{8}$ "				
Sehna $\frac{4}{4}$ "				
Oneida Rugs, Weaving				
" Carpet "				
Amsterdam Rugs "				
Shuttleworth " "				
Sehna Rugs "				
French Wilton " "				
Sehna carpet "				
Imperial " "				
Kilmarnock " "				
Total Loom Preparation				
Total Weaving Labor				
Expense burden				

Elements	PRODUCTION Yards	PRODUCTION Cost	COST PER YARD This Period	COST PER YARD Av. 3 Periods
FINISHING				
Operations, all product				
" sewed Rugs				
Baling Carpet				
Diffused Labor				
Expense Burden				
Power Cost				
Imperial Shipped				
Kilmarnock "				
Oneida "				
WAREHOUSING				
Oneida handled				
Amsterdam "				
Shuttleworth "				
Sehna "				
French Wilton "				
Burlap, Twine, etc				
Stor. & Shpg. Labor				
Trucking				
Expense Burden				
Cost per yard				
Av. yds. per rug				
Cost per rug				

FIG. 175. Process Cost Summary. Individual Determinations. Suggested size, 14" x 8½".

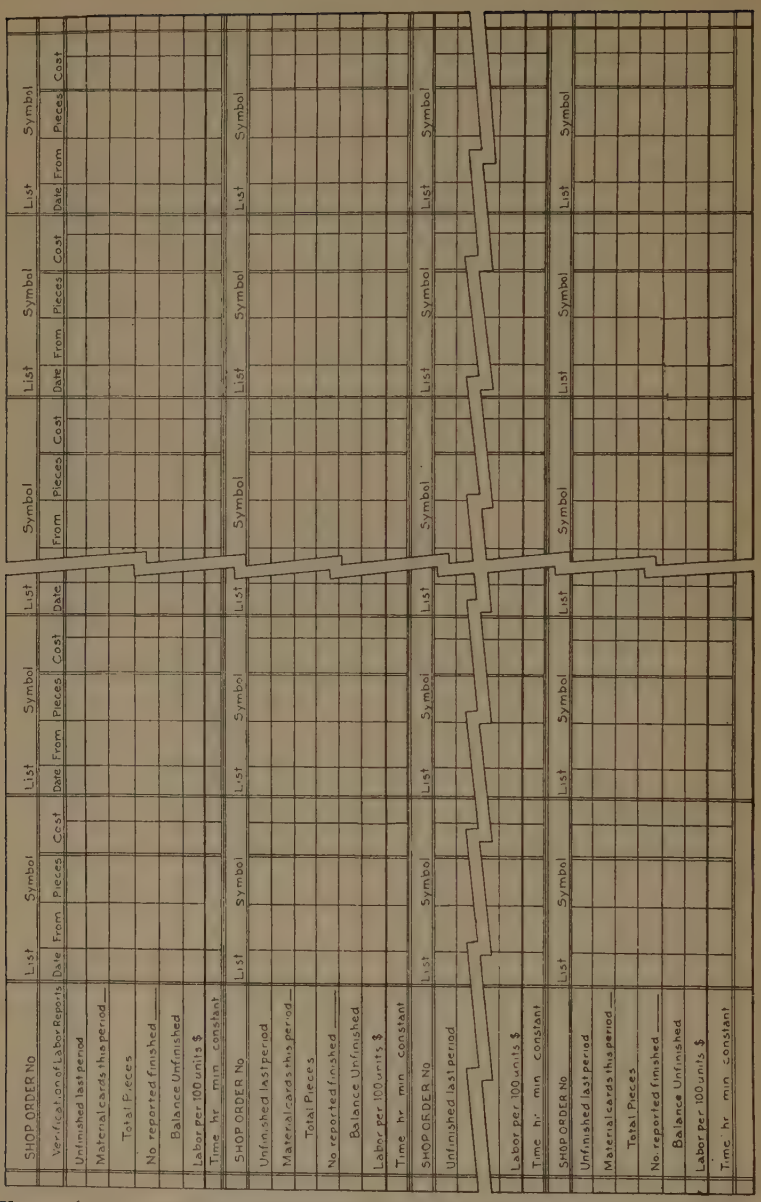


FIG. 176. Process Cost Summary: One Operation—Face of Page. (See § 321.) Suggested size, 17″x14″.

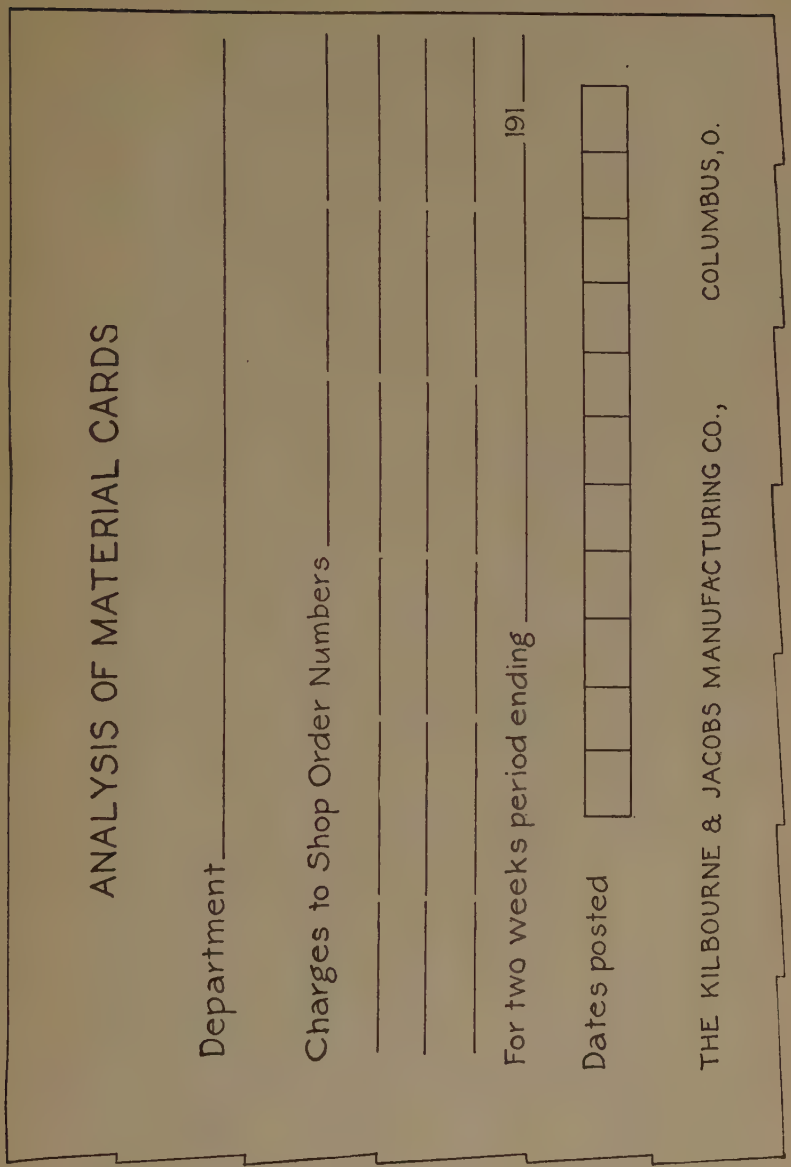


FIG. 177. Process Cost Summary. Material or Parts—Reverse of Page. (Upper right-hand corner.)

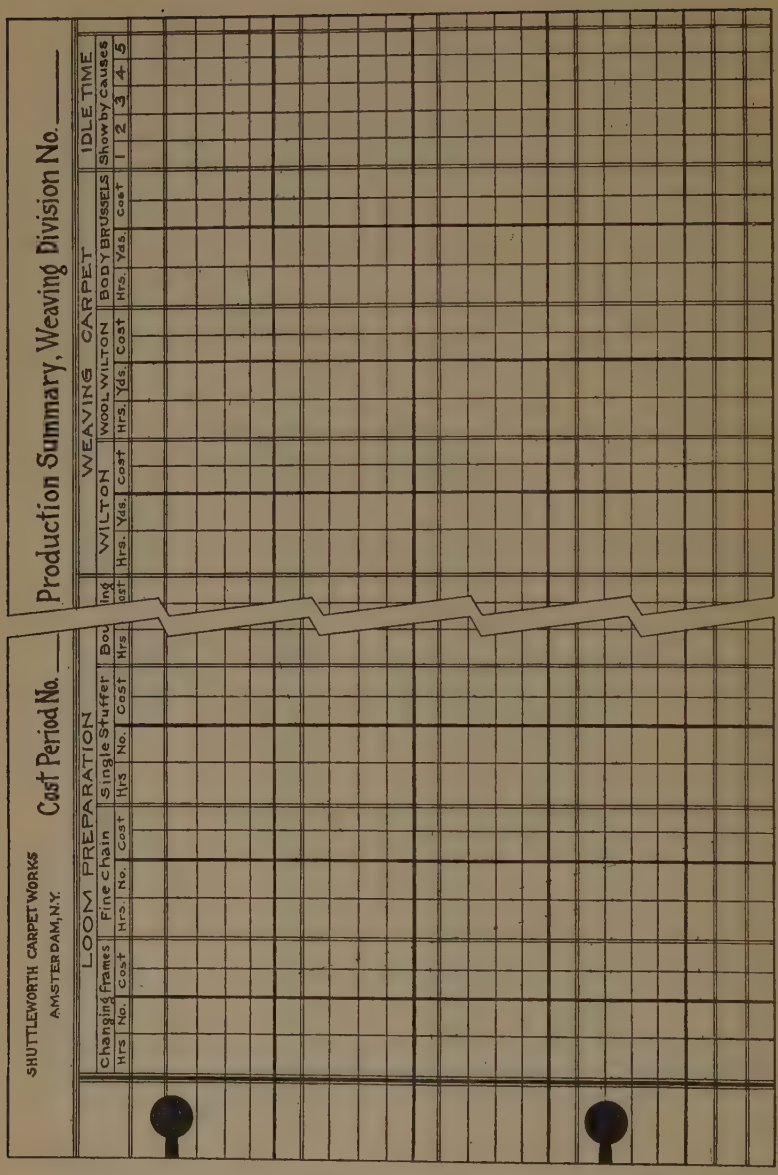


FIG. 178. Four-Week Summary of Machine Time. (See §§ 238, 274, 321.) Suggested size, 14″x8½″.

Record of Machine Hours and Production, month of _____ 191_

Date	MACHINE No._____ Preparation	Running	Quantity	Non-chargeable	Idle Time	MACHINE No._____ Preparation	Running	Quantity	Non-chargeable	Idle Time	MACHINE No._____ Preparation	Running	Quantity	Non-chargeable	Idle Time	Date
1																1
2																2
3																3
4																4
5																5
6																6
7																7
8																8
9																9
10																10
11																11
12																12
13																13
14																14
15																15
16																16
17																17
18																18
19																19
20																20
21																21
22																22
23																23
24																24
25																25
26																26
27																27
28																28
29																29
30																30
31																31
Totals																Totals

FIG. 179. Monthly Summary of Machines. (See §§ 216, 238, 243, 275, 321.) Suggested size, 14"x8½".

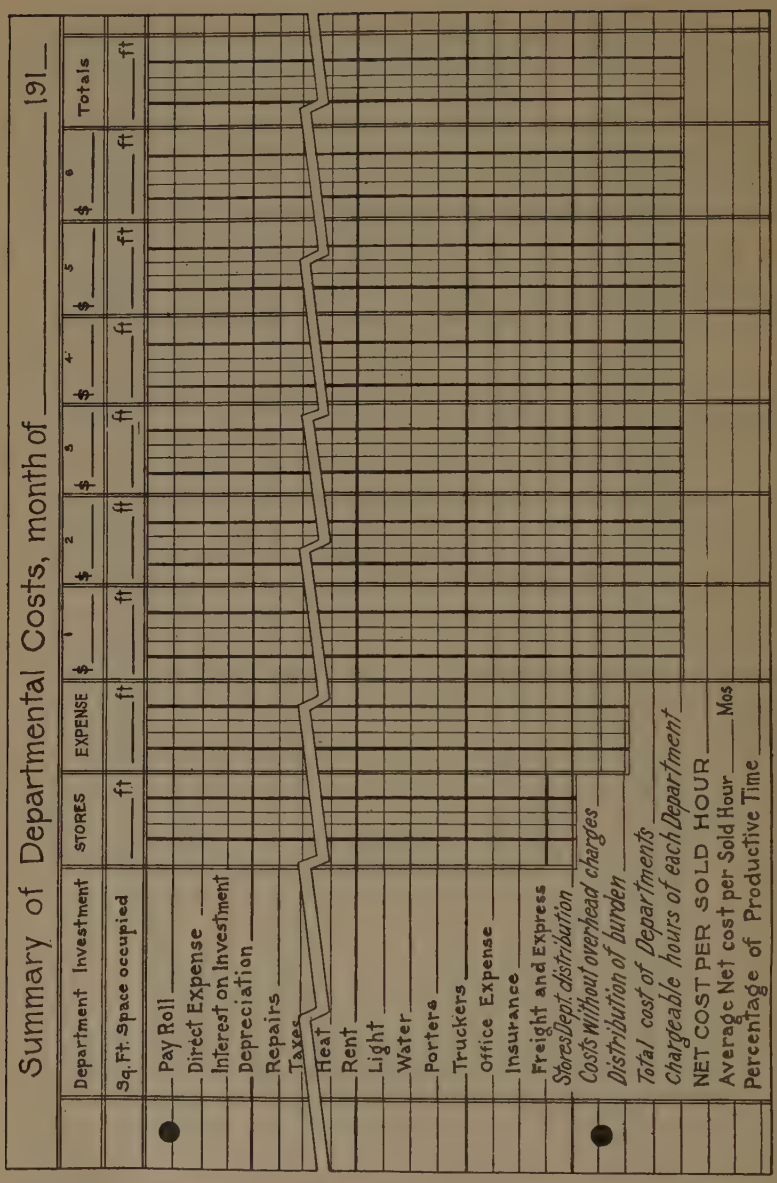


FIG. 180. Summary of Departmental Process Costs. (See §§ 210, 218, 219, 242, 249.) Suggested size, 14"x8½".

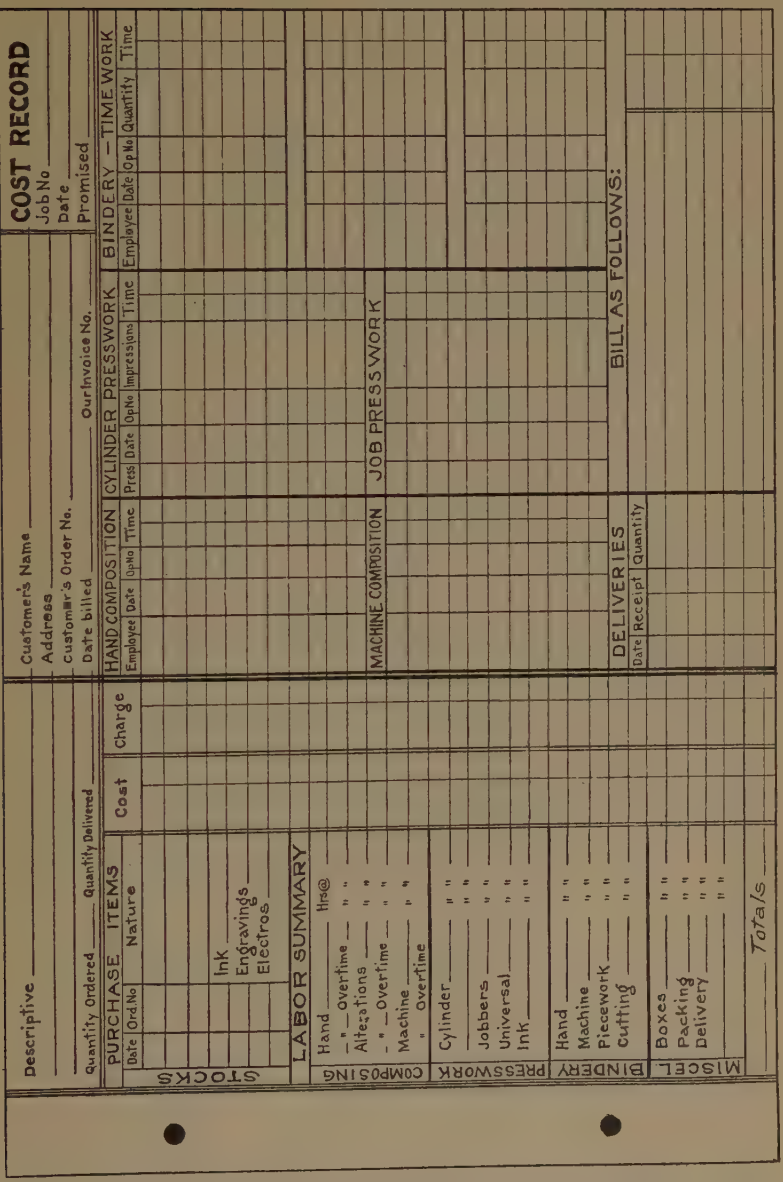
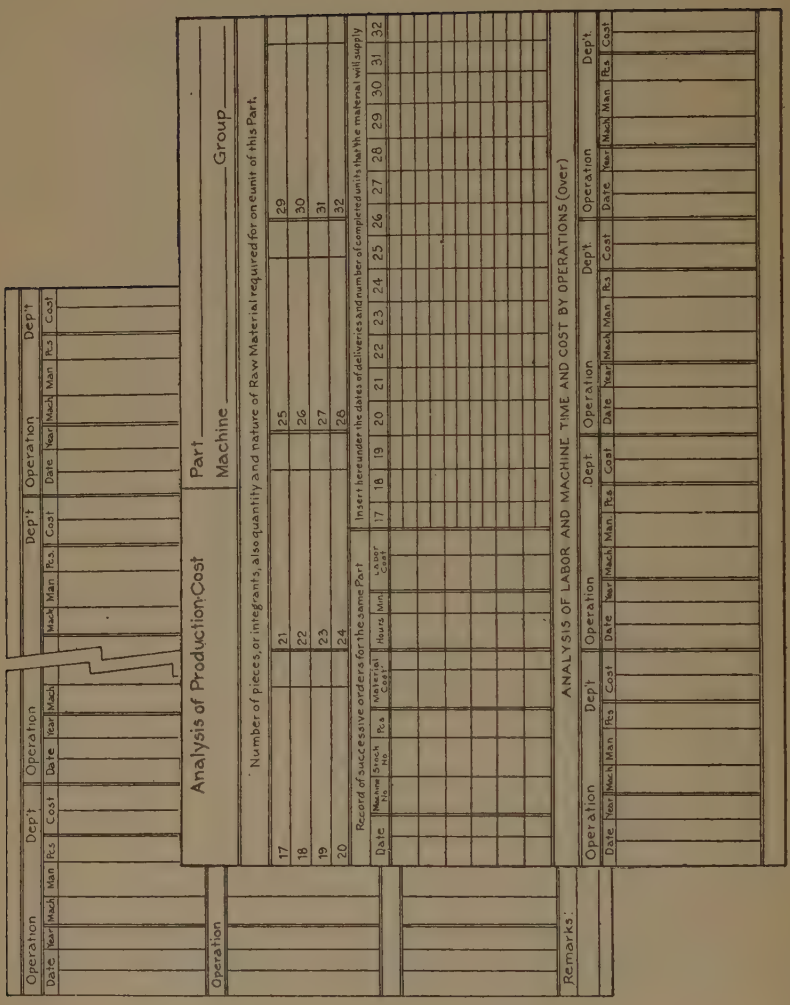
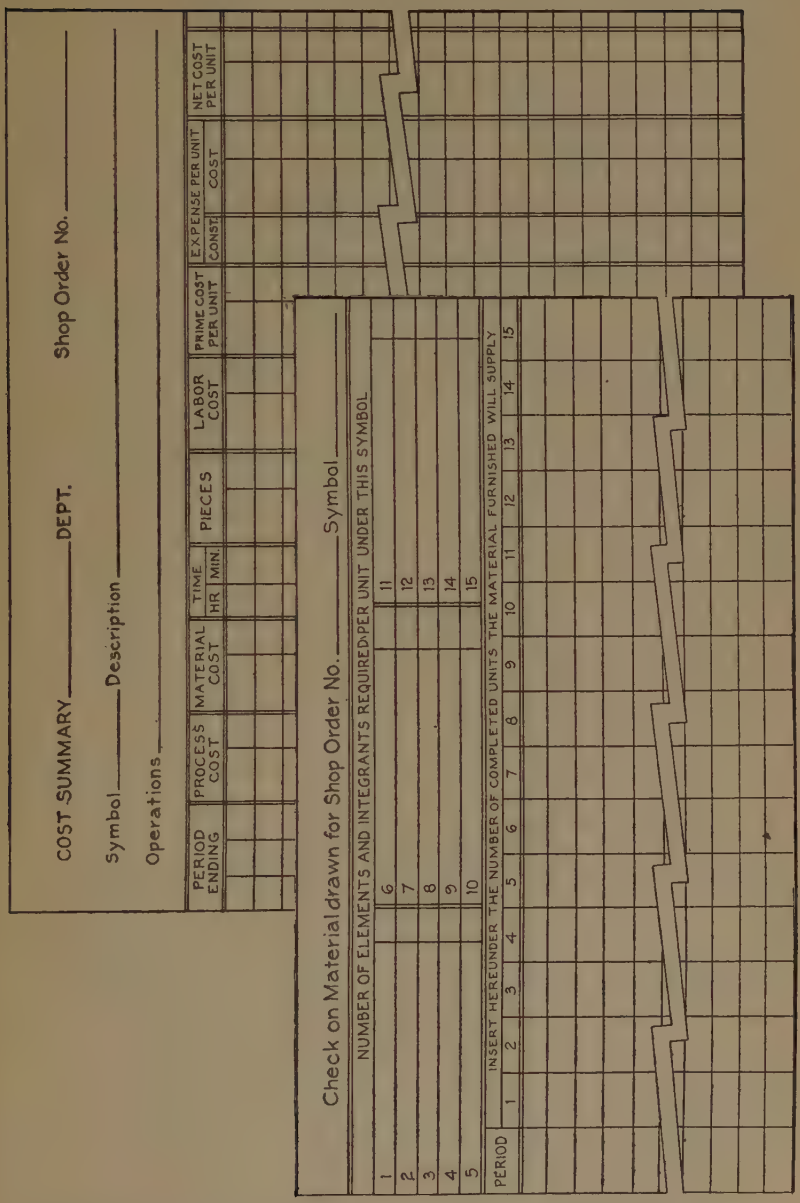


FIG. 181. Specific Job Cost Collating Record. Special Product. (See §§ 211, 213.) Suggested size, 11"x8½".


Analysis of Production-Cost
Part
Machine
Group
Number of pieces, or integrants, also quantity and nature of Raw Material required for on Unit of this Part.
Record of successive orders for the same Part
Insert here under the dates of deliveries and number of completed units that the material will supply
ANALYSIS OF LABOR AND MACHINE TIME AND COST BY OPERATIONS (Over)
Operation
Dept
Date
Year
Mach
Man
Pcs
Cost
Remarks:

FIGS. 182 (Lower), 183 (Upper). Specific Job Cost Collating Record. Standard Product. (See §§ 277, 321.) Suggested size for each, 10″x7″.


COST SUMMARY _____ DEPT. Shop Order No. _____
Symbol _____ Description _____
Operations _____
PERIOD ENDING
PROCESS COST
MATERIAL COST
TIME HR MIN
PIECES
LABOR COST
PRIME COST PER UNIT
EXPENSE PER UNIT CONST. COST
NET COST PER UNIT
Check on Material drawn for Shop Order No. _____ Symbol _____
NUMBER OF ELEMENTS AND INTEGRANTS REQUIRED PER UNIT UNDER THIS SYMBOL
1 6 11
2 7 12
3 8 13
4 9 14
5 10 15
PERIOD
INSERT HEREUNDER THE NUMBER OF COMPLETED UNITS THE MATERIAL FURNISHED WILL SUPPLY
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

FIGS. 184 (Upper), 185 (Lower). Process Cost: Indeterminate Quantity—Face and Reverse of Page. (See § 321.) Suggested size, 8″x10″.

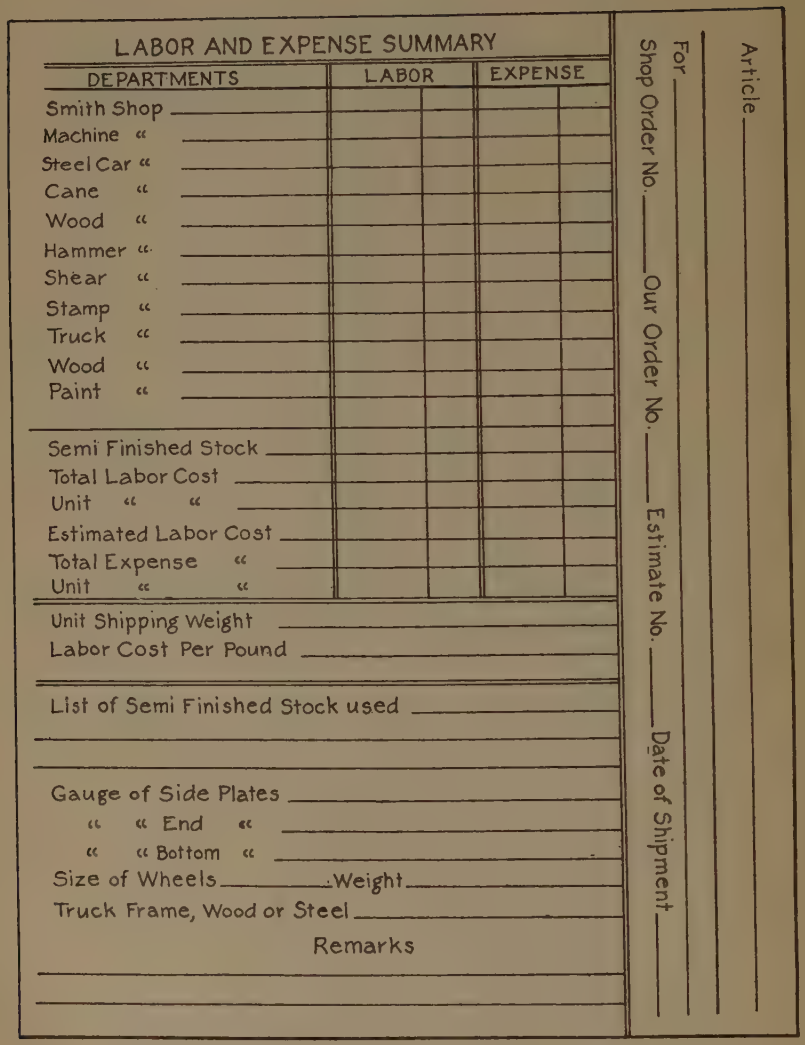


FIG. 186. Process Cost Summary. (See § 321.) Suggested size, 8″x6″.

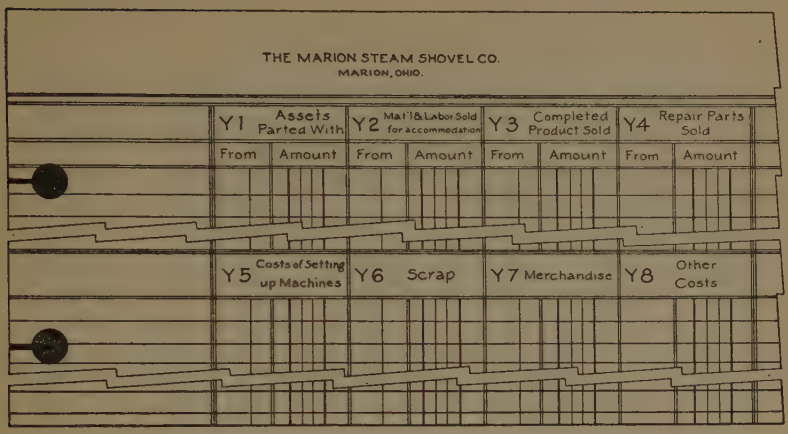


FIG. 187. Analysis Sheet—Left Half. See size below.

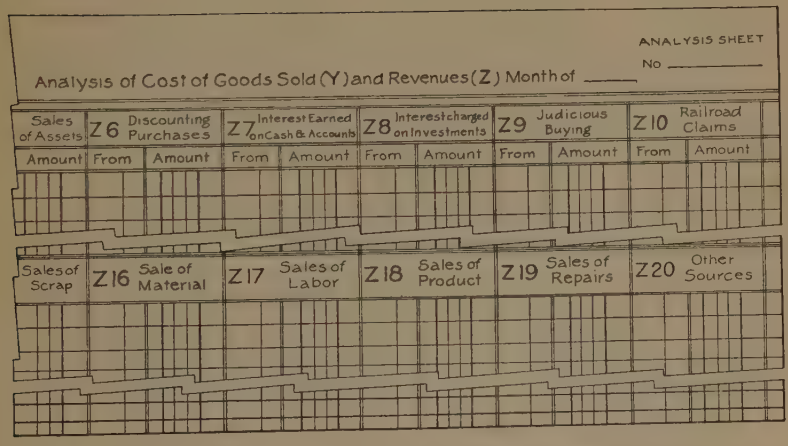


FIG. 188. Analysis Sheet—Right Half. Suggested size, complete form, 14"x8½".

Cost Record, Machine No. _____

Machine _____ Factory No _____
Purchased from _____ Date _____
Description _____

Motor _____ Factory No. _____
Horse-Power _____ Kilowatts _____ Rev per min _____
Purchased from _____ Date _____
Description _____

Power Units _____

Air Hoist _____ Air Units _____
Purchased from _____ Date _____
Remarks _____

Crane _____

Shafting, Special Tools and Supplies _____

Oil or Gas Units _____

Memoranda of repairs made _____

Items	Value	CHARGES Per Annum	CHARGES Per Month
Machine _____ (Interest)			
Motor "			
Shafting "			
Crane and Hoist "			
Special Supplies "			
Building Space			
Repairs (Reserve)			
Depreciation			
Taxes			
Insurance			
Totals			

Location _____
Building No. _____ Square feet occupied _____

Month	ANNUAL COSTS	TERM COSTS	CREDITS	EXCESS Dr	EXCESS Cr.
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Totals					

SEE REVERSE FOR RECORD OF OTHER YEARS

Fig. 189. Machine Installation and Maintenance Record. (See §§ 118, 238, 239, 245, 254, 259, 270.) Suggested size, 11"x8½".

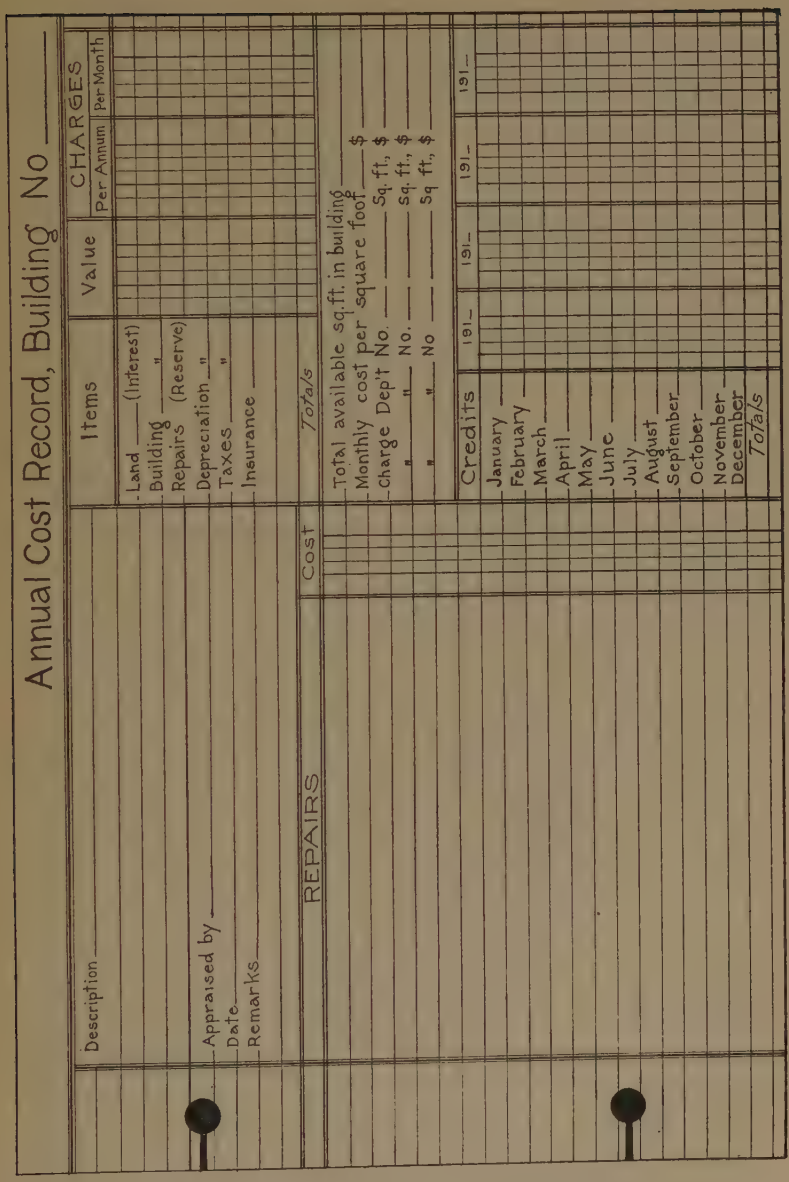


FIG. 190. Building Factor Record. (See § 118.) Suggested size, 11″x8½″.

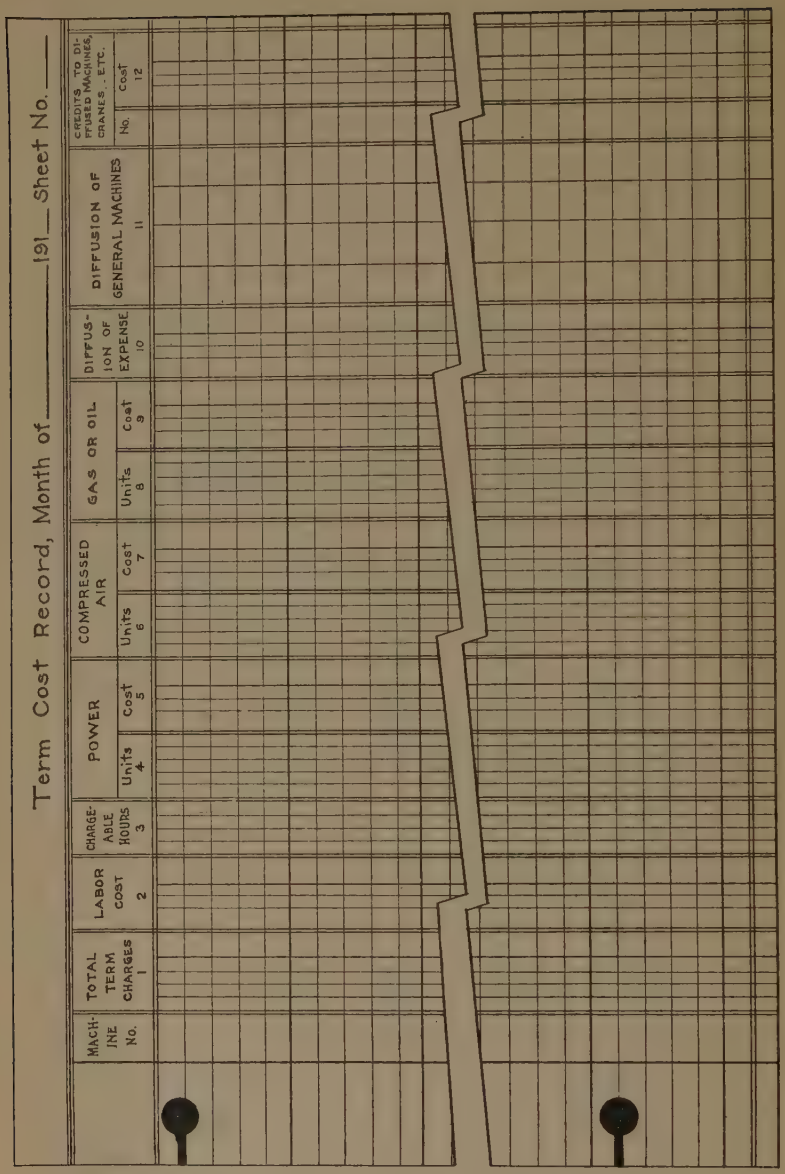


FIG. 191. Term Cost Record. (See §§ 146, 230, 241, 242, 249.) Suggested size, 11″x8½″.

DAILY CUPOLA RECORD

THE ROCK ISLAND PLOW CO.
ROCK ISLAND, ILLS.

Date _____

MATERIAL	LBS.	PRICE	COST
Clifton			
Silver			
Etowah			
Pioneer			
Chattanooga			
Scrap*			
Gates and Sprues			
Over Iron			
Total lbs. Iron			
Coke			
Wood			
Total lbs. Fuel			
Total Iron Melted			
Less Gates and Sprues			
Net Iron Melted			
Good Castings (cost per lb. $0.___)			
Loss			

Proportion Iron Melted to Fuel used _____ %
Proportion Good Castings to Fuel used _____ %
* At Scrap Cost

CARBON COPY RETAINED IN ORIGINAL BINDING

FIG. 192. Daily Report of Iron Foundry. Suggested size, 6"x9".

THE MARION STEAM SHOVEL COMPANY

HEAT REPORT Heat No _____ Furnace No _____

OPEN HEARTH STEEL FOUNDRY Date _____ 191__

Commenced Charging _____ M. Finished Charging _____ M; Tapped _____ M

Condition of bottom after Heat _____

No heats since last repairs _____ This is a correct report _____ Melter

CHARGE		SUNDRIES	
Pig Iron		Nozzle Bricks	No
"		Sleeve	No.
"		Black Leads	
"		Tar	Qts
Wheels		Magnesite	Lbs
Borings C I		Dolomite	"
Scrap Cast Iron		Oil used	Gals.
" Foundry		Gas Meter at Tapping	
" " risers		Gas Meter at Charging	
" Defective Castings Fdy		Gas Meter at Last Heat	
" Foundry Ingots		Total Consumption	
" Returned Castings			
" Sheet		Coke in cupola	Lbs
" Steel		Lime	
" Forge			
" Structural			
Turnings, Steel		Lime Stone	
		Fluorspar	
Ferro Manganese			
" Silicon			
" Silicon E			
Carbide of Silicon			
Spiegel			
Block Aluminum			
Rod "			
Ore, use one-half of weight		Time first Test sent to Chemist	
Total charge		Ph of first Test	
Less Gates, Risers, Highballs, etc		Final Test	
Net Metal Melted		Chemist	

FIG. 193. Daily Report. Open Hearth Steel Foundry. (See § 321.) Suggested size, 8"x10".

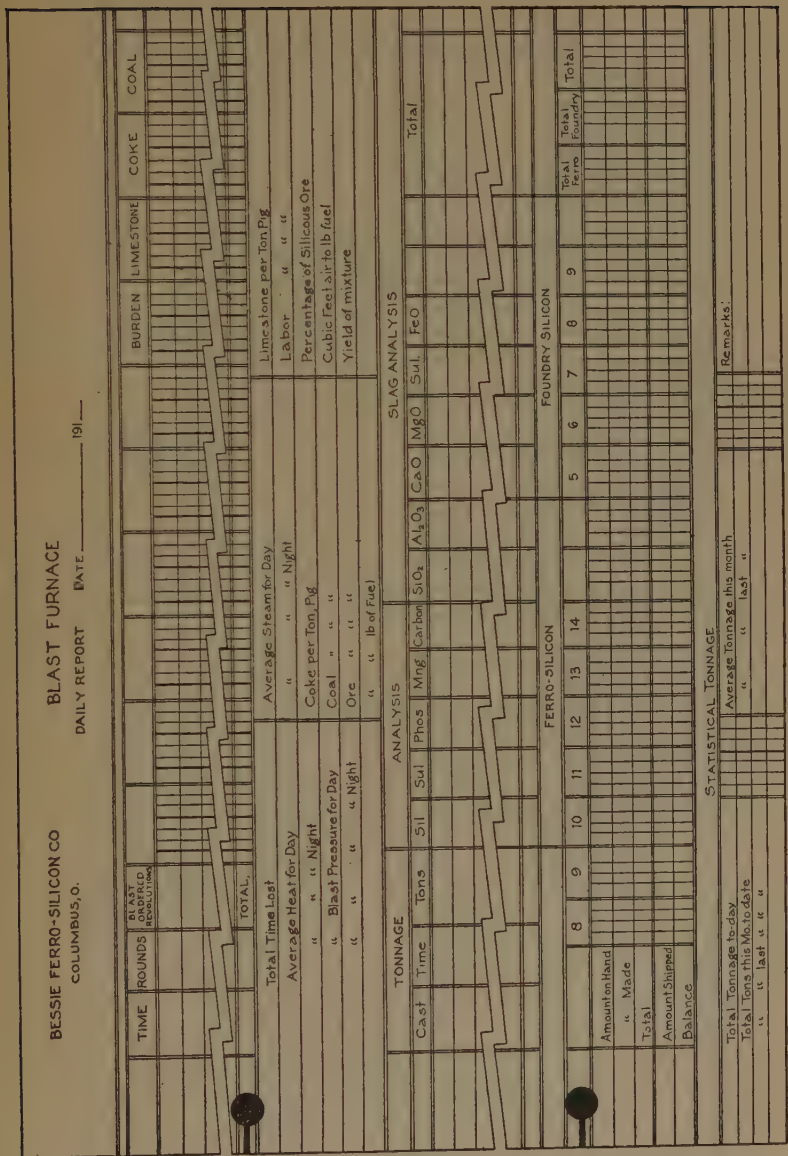
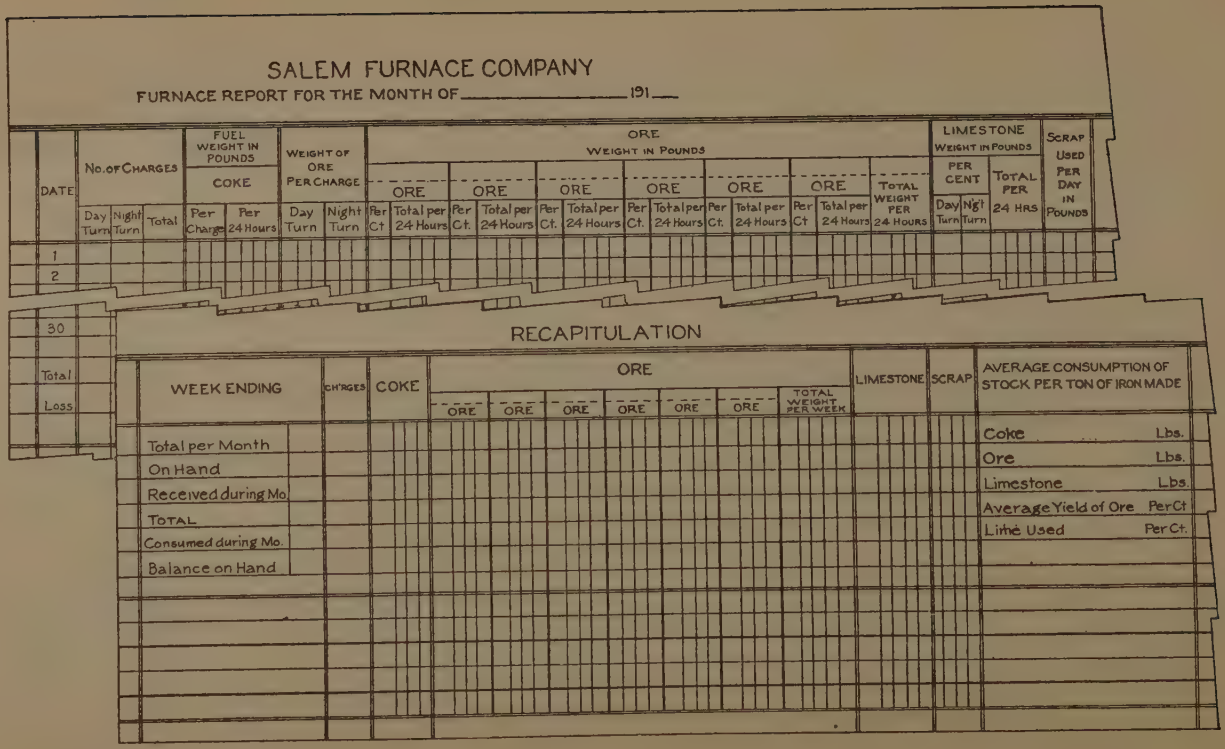
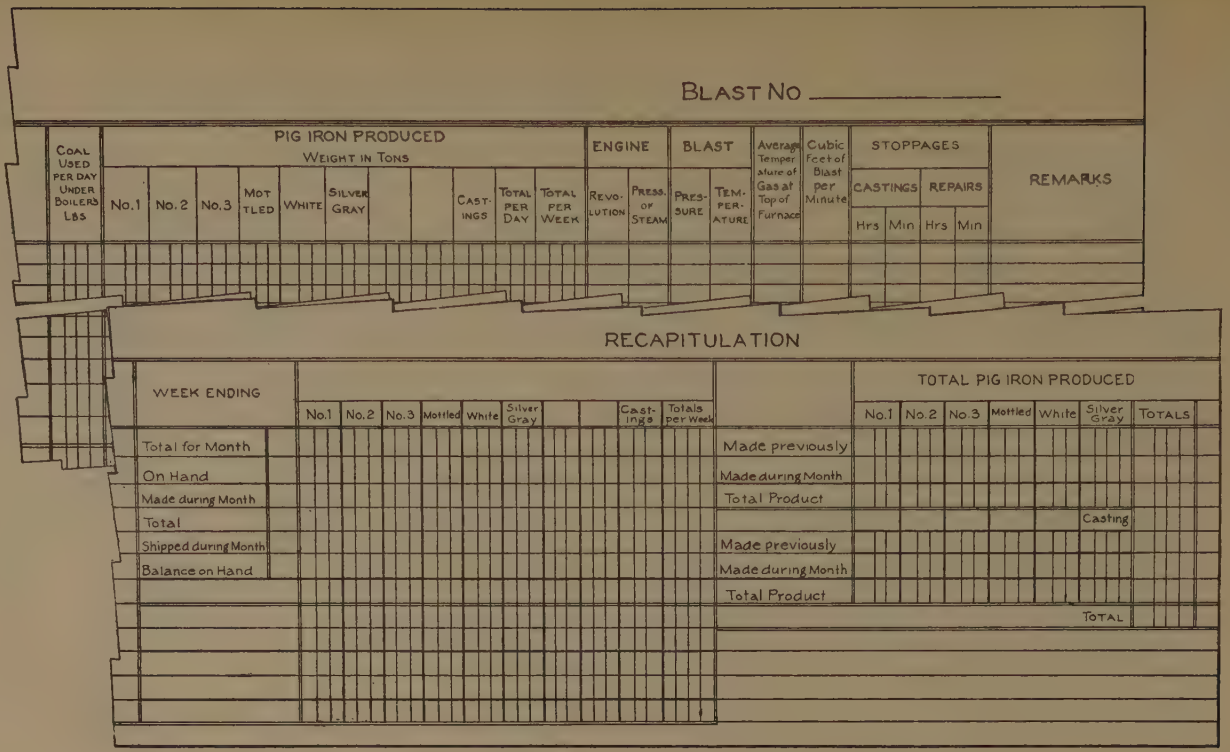


FIG. 194. Daily Report. Blast Furnace. (See § 321.) Suggested size, 14"x17".



FIGS. 195 (Upper), 196 (Lower). Monthly Summary: Blast Furnace—Left Portion. (See § 321.)
Suggested size, complete sheet, 18"x23".



FIGS. 197 (Upper), 198 (Lower). Monthly Summary: Blast Furnace—Right Half.
Suggested size, complete form, 18″x23″.

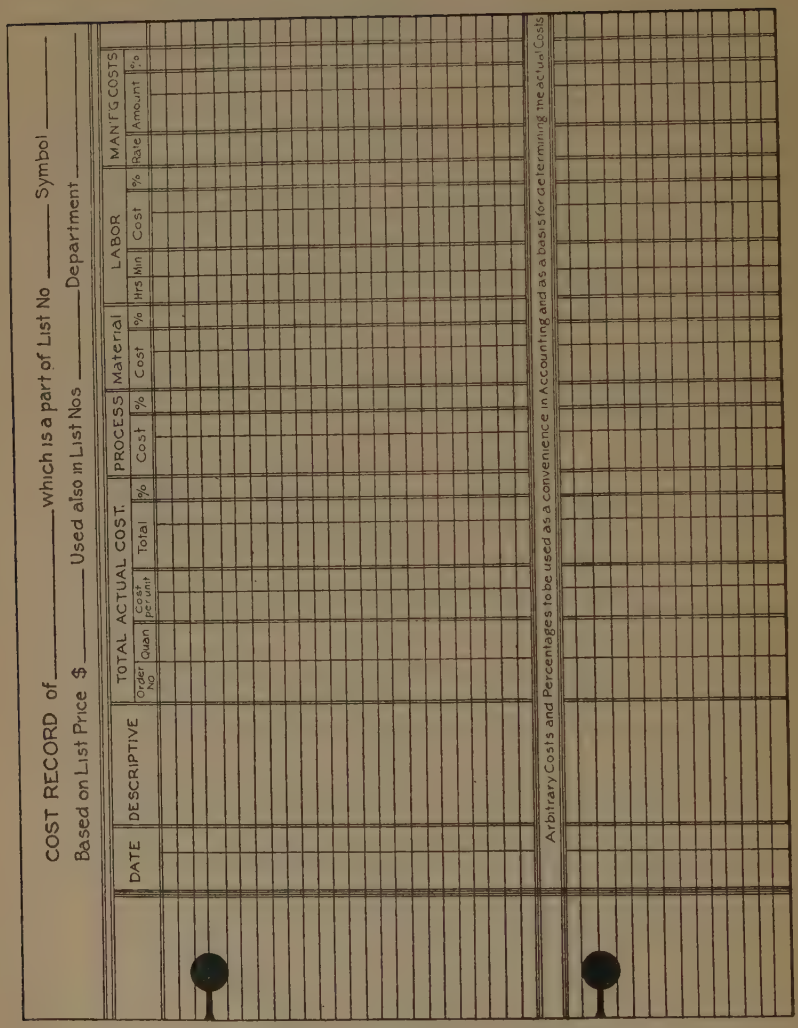


FIG. 199. Summary and Comparison of Costs. (See §§ 224, 228, 229, 232.) Suggested size, 11″x8½″.

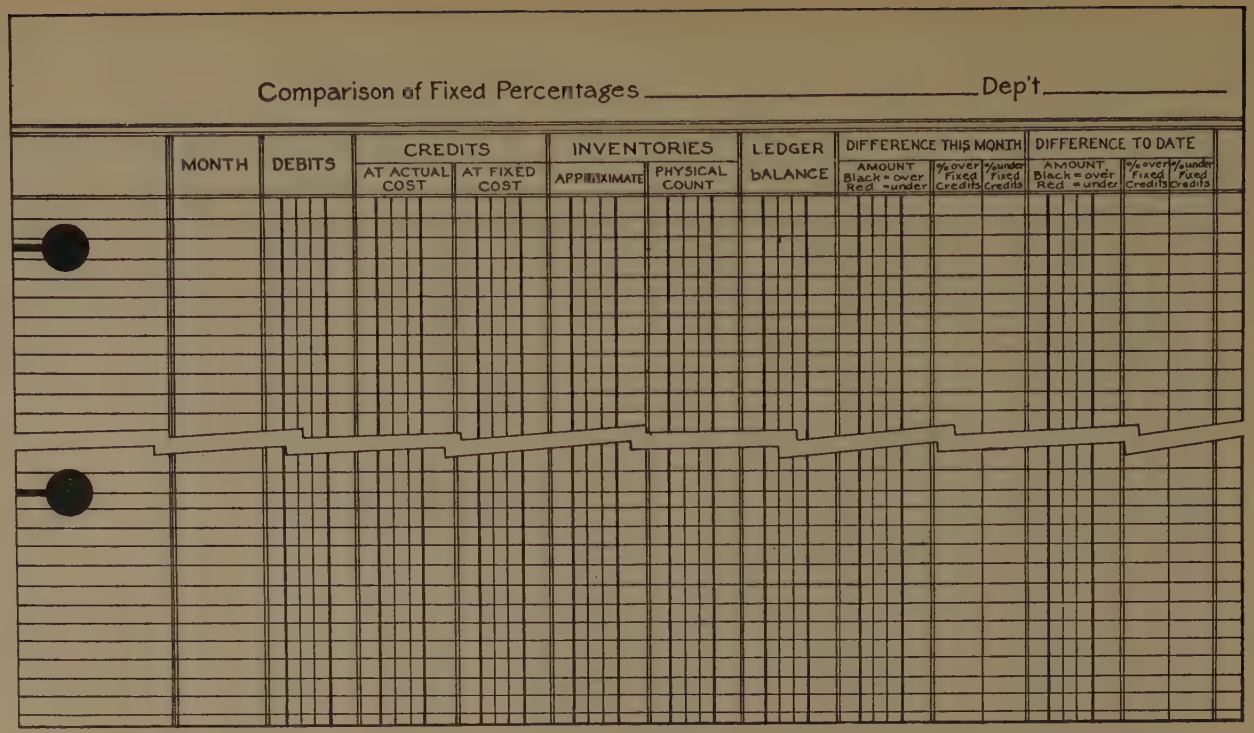


FIG. 200. Comparison of Fixed List Percentages. (See §§ 230, 234, 235, 321.) Suggested size, 11″x8½″.

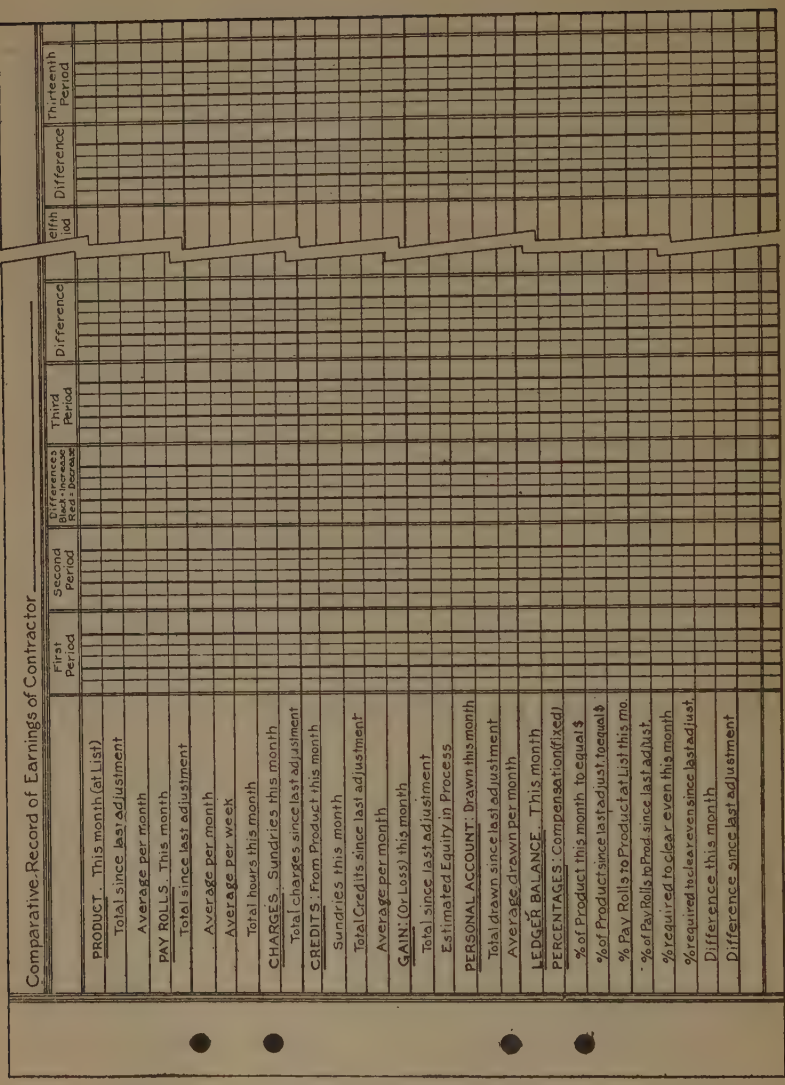

Comparative Record of Earnings of Contractor
First Period
Second Period
Differences Red = Increase Red = Decrease
Third Period
Difference
Eleventh Period
Difference
Thirteenth Period
PRODUCT: This month (at List)
Total since last adjustment
Average per month
PAY ROLLS: This month
Total since last adjustment
Average per month
Average per week
Total hours this month
CHARGES: Sundries this month
Total charges since last adjustment
CREDITS: From Product this month
Sundries this month
Total Credits since last adjustment
Average per month
GAIN: (Or Loss) this month
Total since last adjustment
Estimated Equity in Process
PERSONAL ACCOUNT: Drawn this month
Total drawn since last adjustment
Average drawn per month
LEDGER BALANCE: This month
PERCENTAGES: Compensation (fixed)
% of Product this month to equal $
% of Product since last adjust. to equal $
% Pay Rolls to Product at List this mo.
% of Pay Rolls to Prod. since last adjust.
% required to clear even this month
% required to clear even since last adjust.
Difference this month
Difference since last adjustment

FIG. 201. Comparative Record of Contractor's Earnings. (See §§ 73, 230, 321.) Suggested size, 9″ deep x 6, 12 or 13 periods wide.

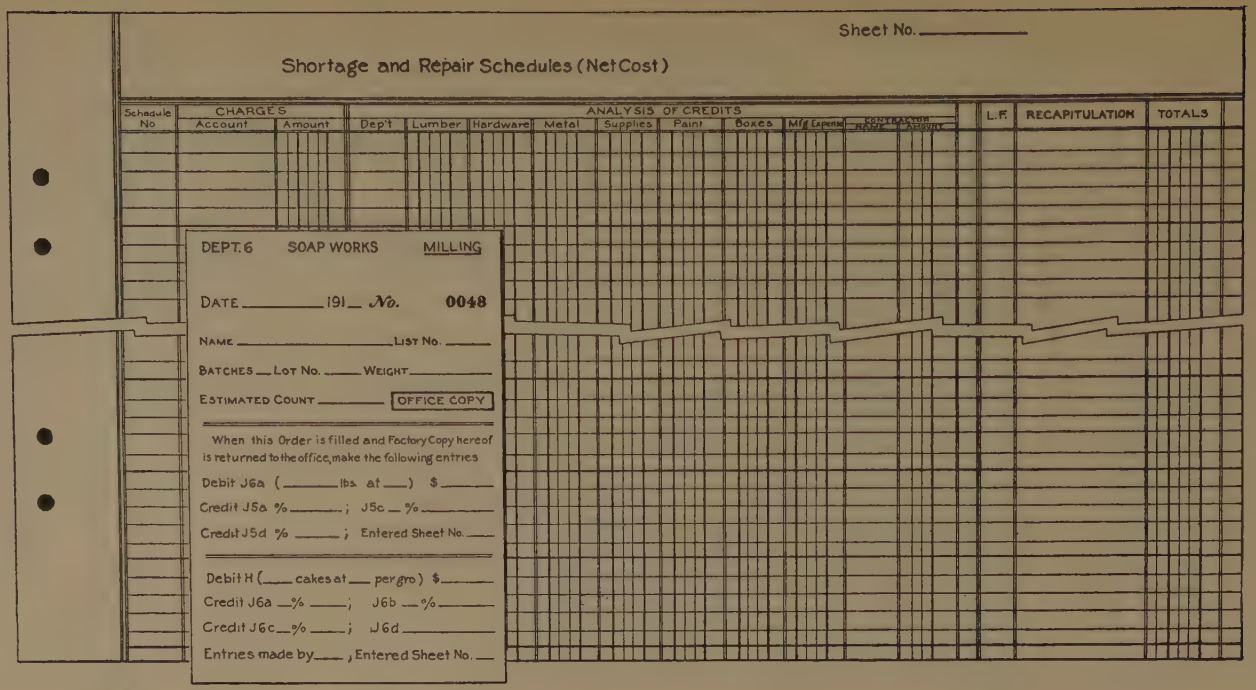


FIG. 202 (Smaller). Office Copy of Factory Schedule. (See §§ 225, 321.) Suggested size, 4″x6″.

FIG. 203 (Larger). Record of Costs of Work. (See § 73.) Suggested size, 16″x50 lines.

CHAPTER XLIII.

CONTROLLING AND FINANCIAL FORMS.

§ 323. Comment on Forms of Chapter.

General and Factory Exhibits are fully treated in Chapter XXXIV. Financial records are discussed in § 299. Text references will be found immediately following the title of each form.

Figures 204 to 207. General Exhibit. On account of the number of columns necessary on this form of the General Exhibit, it is bound up with long and short leaves on the principle of the master sheet and slip sheet. The left face of the long leaf corresponds to the master sheet, the column for descriptive matter appearing at its left-hand side. The following short sheet is usually just long enough to strike the inner edge of the descriptive column. In this way a very large number of columns relating to the same general matter may be utilized without rewriting the descriptive matter.

If a book thus composed of long and short leaves is bound up in the usual style, it is obvious that it will be much thicker at the binding edge where both long and short sheets are in evidence, than at the outer edge where only the long sheets appear. This results in a distorted appearance which becomes worse as the book seasons, the covers "caving" inward and the book generally becoming "sloppy."

To prevent this the so-called short sheets are sometimes left of full length, pin-hole perforations at the place where they would otherwise end, enabling the sheet to be torn off at that point when used. This plan is objectionable as giving a rough writing surface on the left-hand sheet where it comes

over the perforated ends of the short sheets and as resulting in the same ultimate condition of the book as when a short sheet is used.

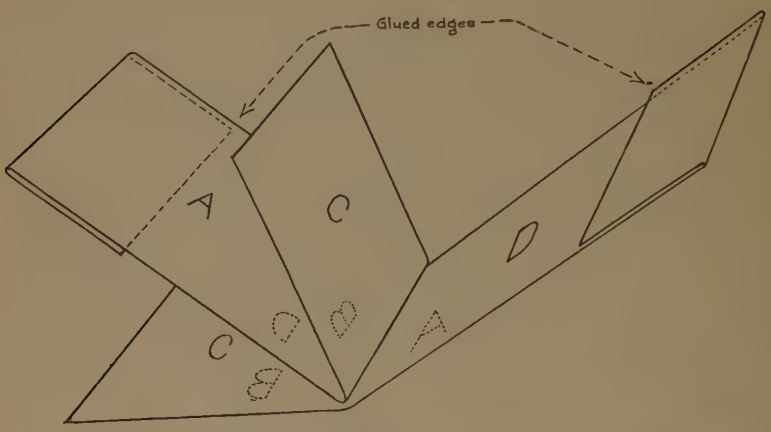
A better plan for preventing the distortion of the book is to provide a compensating reinforcement of the long sheet. For this purpose the sheet is made longer than would otherwise be necessary, the extended portion, or flap, being of such length that when folded back on the sheet of which it is part, it will more or less exactly fill up the space between the end of the short sheet and the outer edge of the book. The flap, or fold of the long sheet, is ruled on the exposed portion so that it forms the outer part of the page, and is glued in position. The general effect of the plan is to make the long sheet of double thickness from the end of the short sheet to the outer edge of the book.

In Figures 204 to 207 the binding fold of the left side of the folio, as shown in Figure 205, comes between "Consignment Accounts" and "Factory Equipment" columns. On the right side of the folio the binding fold, as shown in Figure 206, comes between "Diffused Expense" and "Suspense Items." The right-hand portion of Figure 205 and the left-hand portion of Figure 206 therefore represent the two sides of the short sheet or leaf.

On the long leaf the reinforcement comes on the portion of the sheet shown in Figure 207, reaching from the outer or right-hand edge, over to the extreme left of the "Capital Accounts, Dr." column, at which place the glued flap will end. The exact point at which the reinforcing flap ends, will, of course, vary with different forms but it should always be made to come in such position that figures are not likely to be frequently written over or near its edge.

It is well to omit the reinforcement on every fifth long leaf, for the reason that the glue used to fasten down the reinforcing flap more than compensates for the difference it is desired to overcome; also each folded outer edge helps to build

up a thickness which is a trifle more than would be made by two sheets absolutely flat.



a. Illustration showing construction of book made up of long and short leaves.

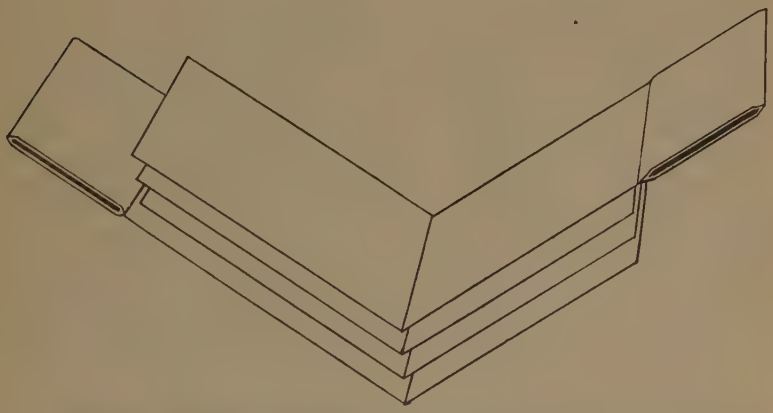
Cut "a" will help to explain the construction of a long and short leaf book. In this cut the long sheets are represented by A and D; A representing the left-hand side of a folio, and D the right-hand side of the same folio. The short sheet coming in between is represented by dotted B, and C; B representing the first page of the short sheet, and C the second page. Under this arrangement, if an entry is made extending across the entire folio, it will begin on A, be continued on B and C, and end on D. The new folio beginning with dotted A, will, if completed, be a duplication of the one just discussed, the page which backs D forming A of the new folio. As will be noted, D of one folio, and A, B, and C of the following folio, are ruled on a single sheet, which is so folded in binding as to make DA the long sheet and BC the short sheet.

The long sheet is folded back, as shown in illustration, sufficiently far to make it a double sheet from the end of short

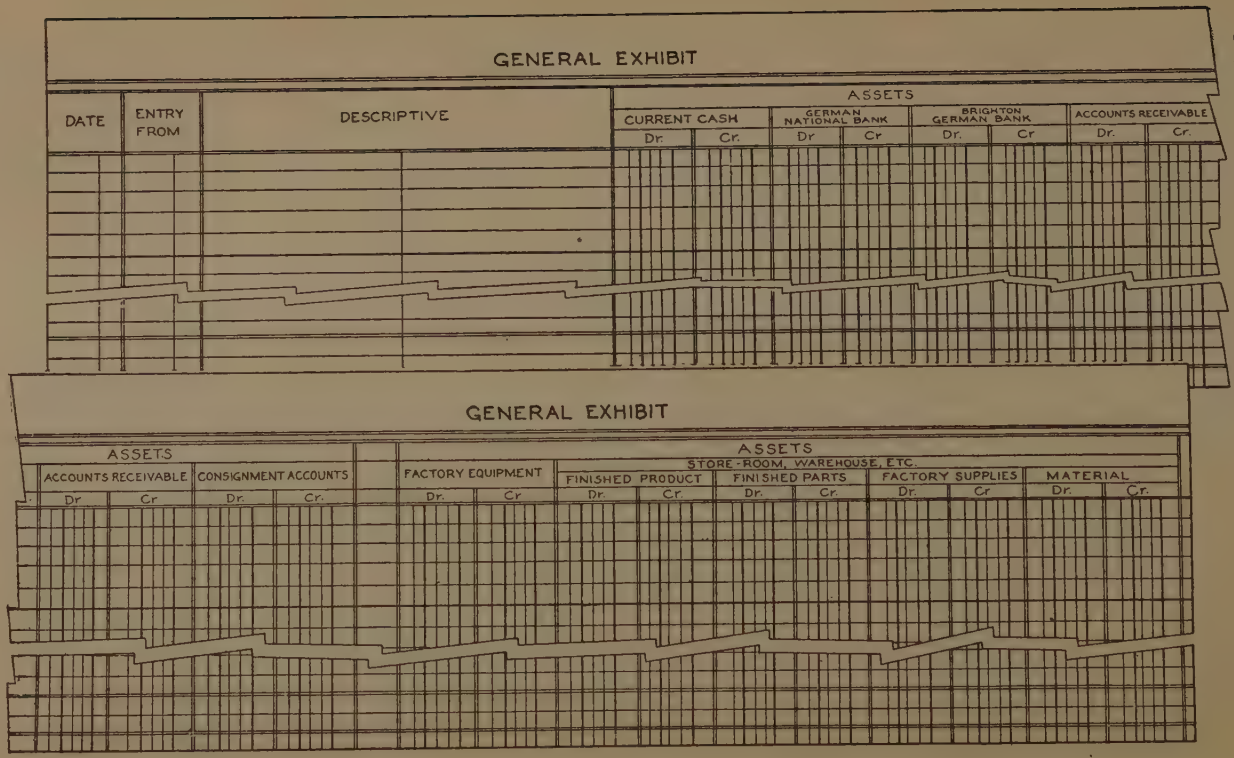
sheet C to the outer extremity of the page. The folded-over portion of the long sheet is glued at the edges only. This point is important as the result is very unsatisfactory when the entire folded-over portion, or flap, is solidly glued down.

Where two or more short leaves intervene between the long leaves, any desired compensating reinforcement can be inserted under the glued fold. Where three short leaves are used, it is better to make the reinforcement consist of a double thick paper glued at top and bottom to the outer part of the long sheet, so as to prevent "gapping."

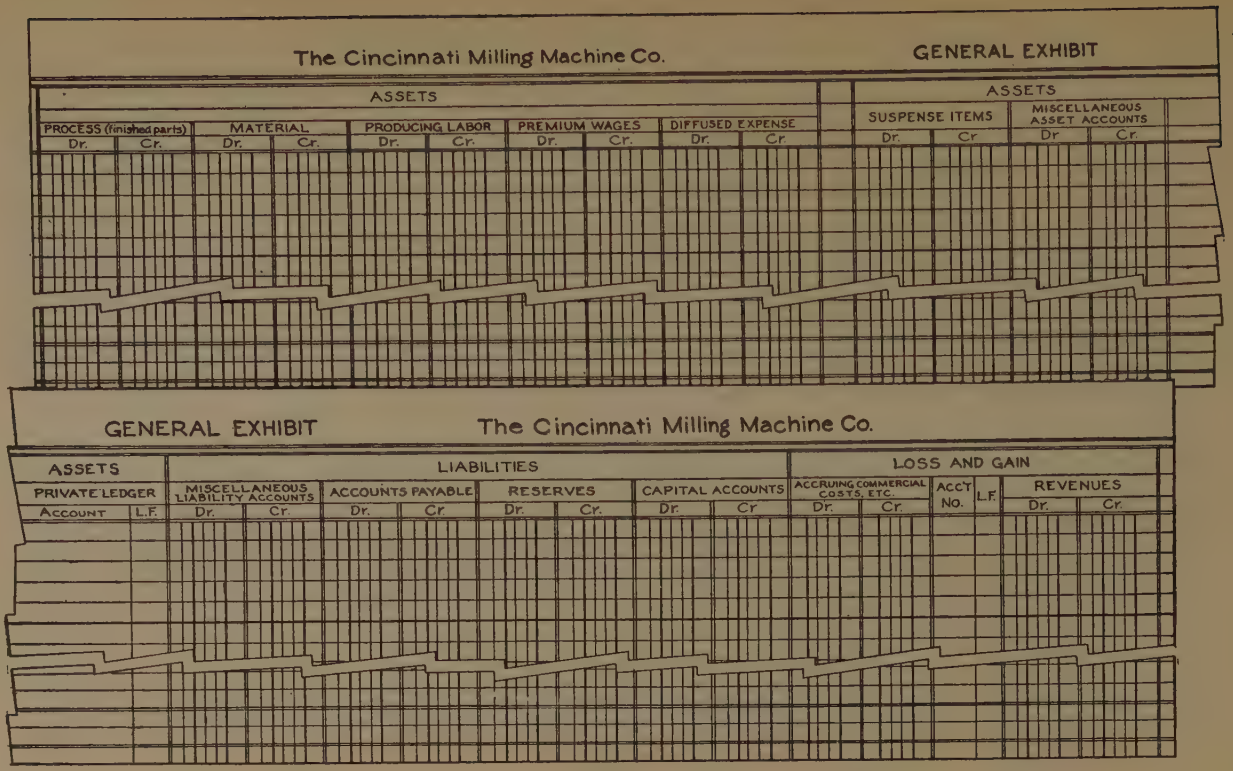
The arrangement of such a book in which one long sheet is followed by two or more short sheets, is shown in cut "b." Here the reinforcing portion of the long sheet is made as thick as may be necessary to equal the thickness of the intervening short sheets. As will be seen, any number of short sheets can be readily provided for by building up the reinforced portion of the long sheet to the desired thickness.



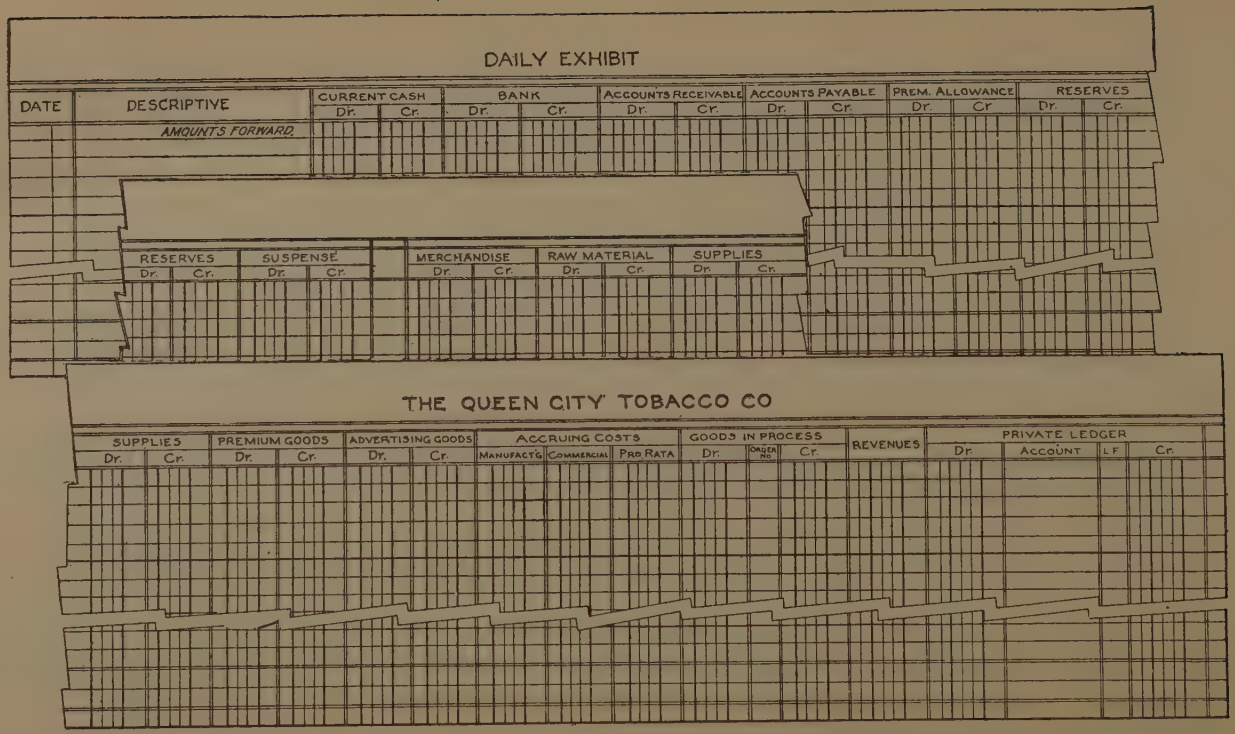
b. Illustration showing construction of book with three short leaves between two long leaves.



FIGS. 204 (Upper), 205 (Lower). General Exhibit: Machine Tool Builders'—Left Page.
(See §§ 56, 303; also Ch. XXXIV.) Suggested size of book, 18″x15″.



FIGS. 206 (Upper), 207 (Lower). General Exhibit: Machine Tool Builders'—Right Page.
Suggested size of book, 18"x15".



FIGS. 208 (Top), 209 (Middle), 210 (Bottom). General Exhibit. Tobacco Works. (See §§ 56, 303; also Ch. XXXIV.)
Suggested size of book, 18″x15″.

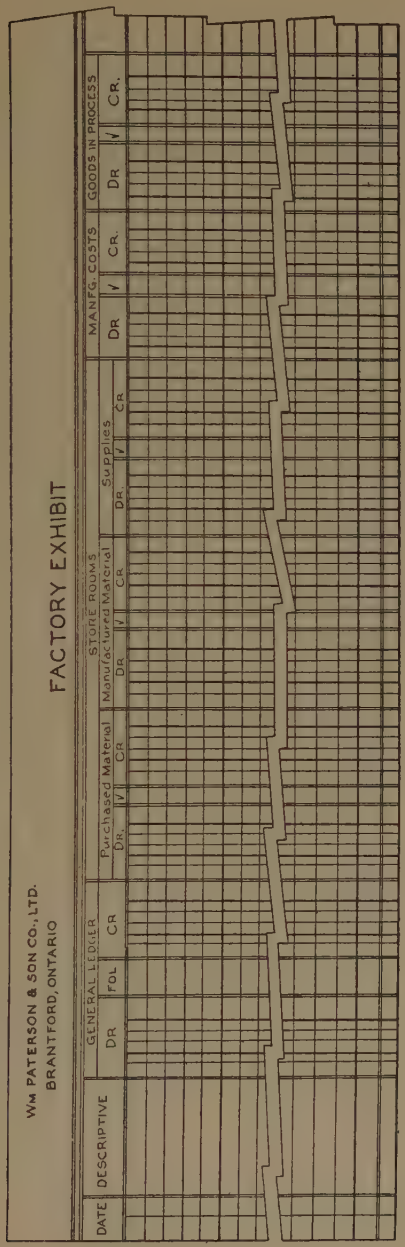
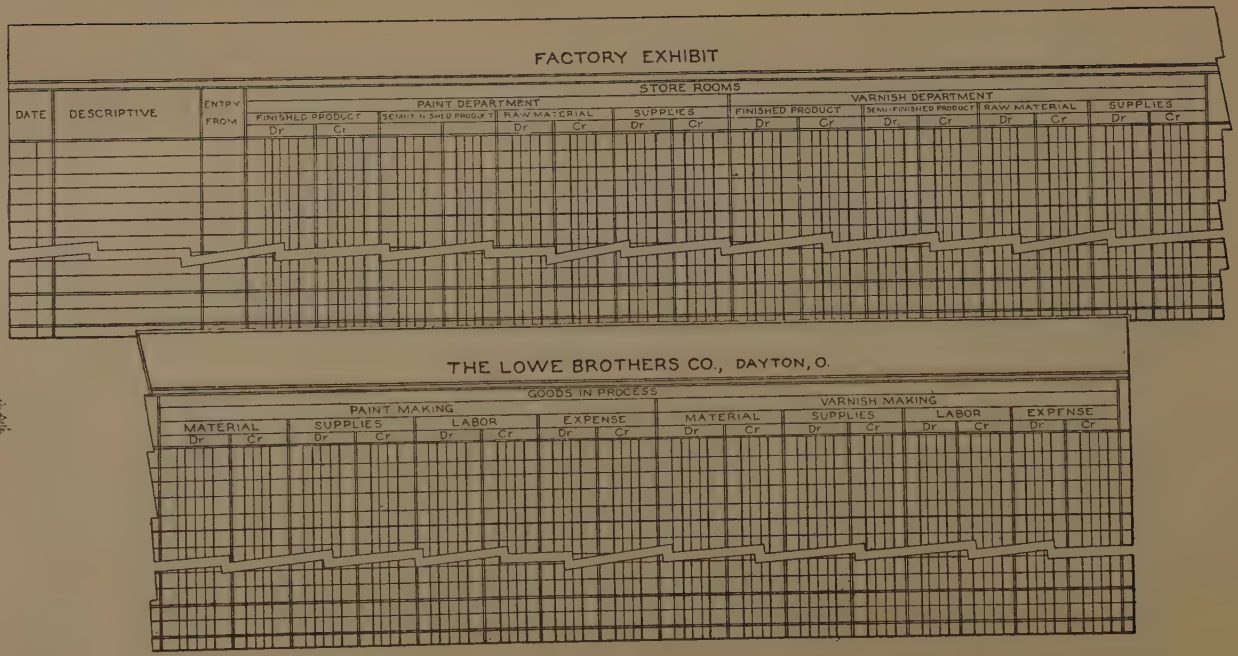
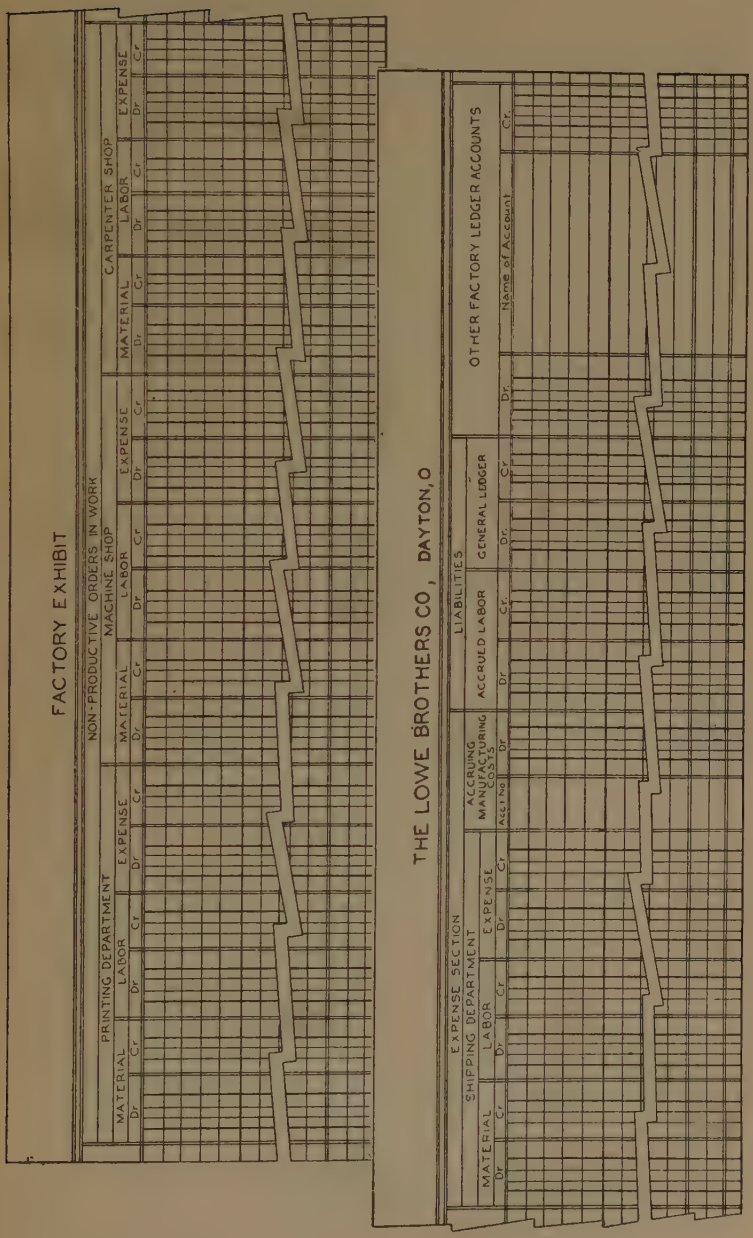


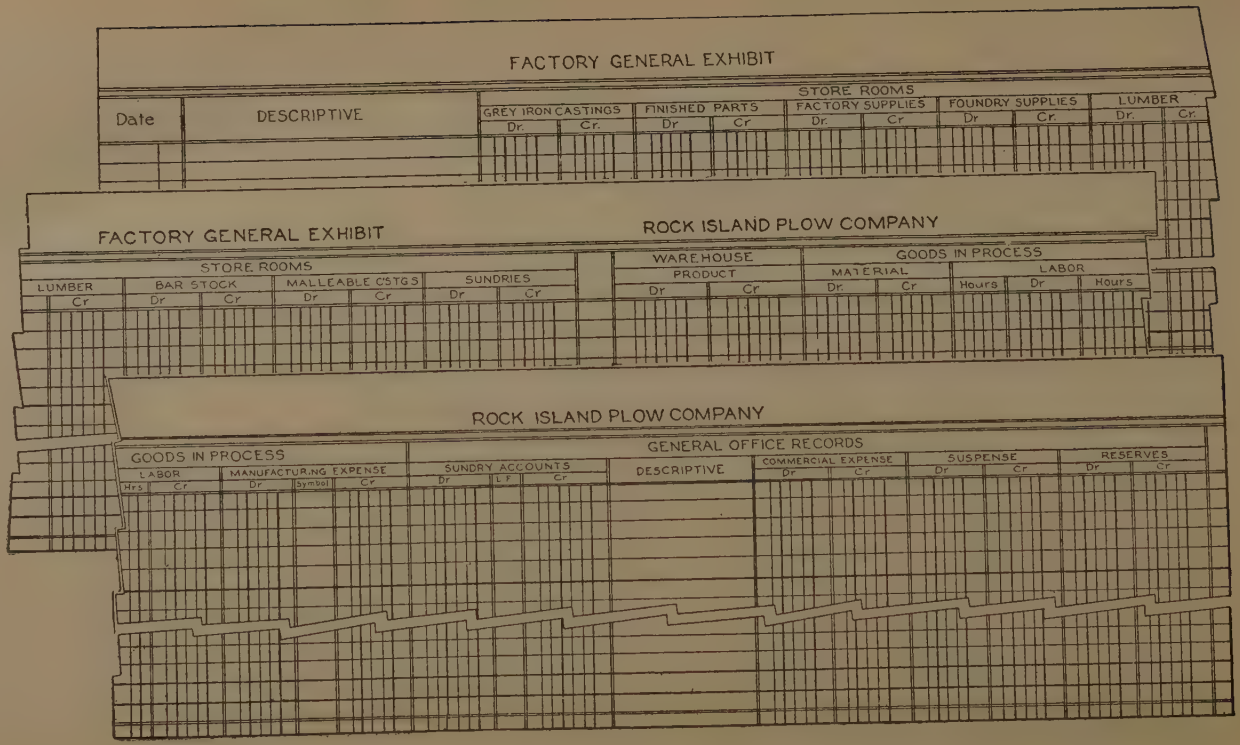
Fig. 211. Factory Exhibit. (See §§ 295, 303.) Suggested size, 14"x62 lines.



FIGS. 212 (Upper), 213 (Lower). Factory Exhibit: Paint and Varnish—Left Page. (See §§ 295, 303.) Suggested size of book, 18″x15″.



FIGS. 214 (Upper), 215 (Lower). Factory Exhibit: Paint and Varnish—Right Page. Suggested size of book, 18″x15″.



FIGS. 216 (Top), 217 (Middle), 218 (Bottom). Factory Exhibit. Agricultural Implements. (See §§ 295, 303.)
Suggested size of book, 20″x15″.

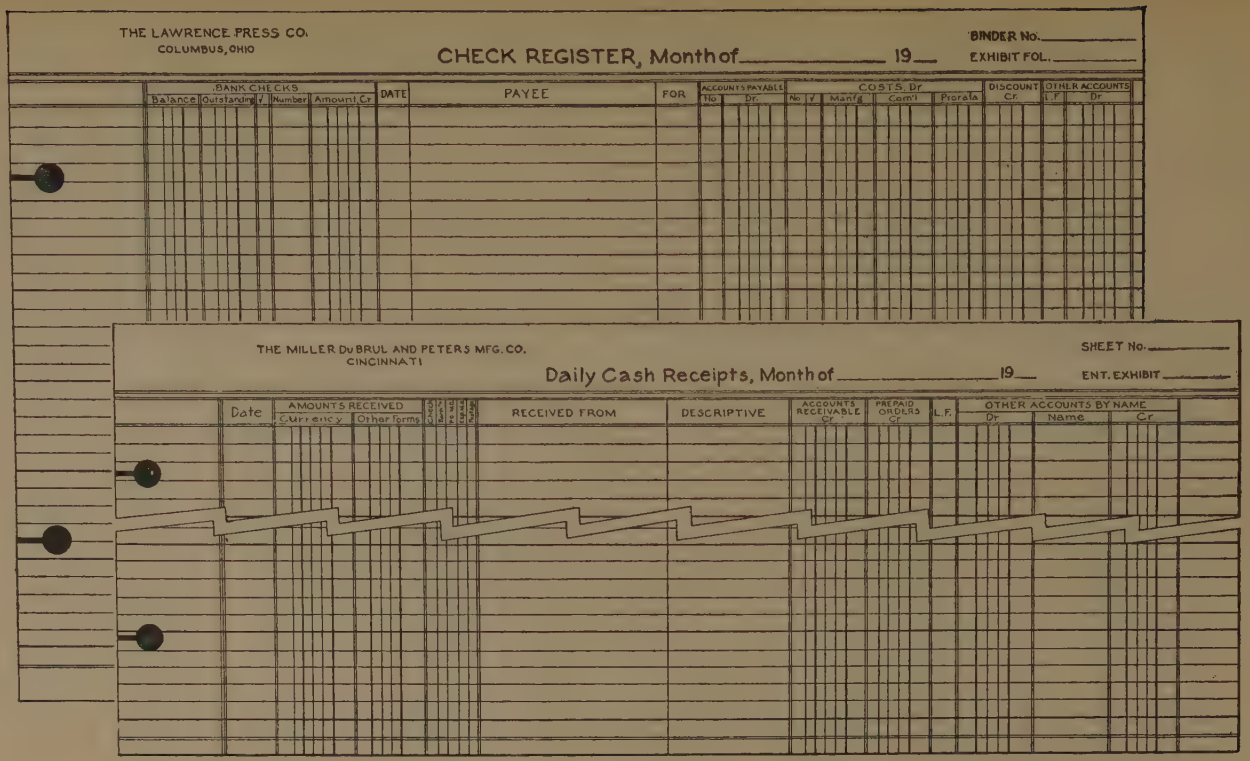
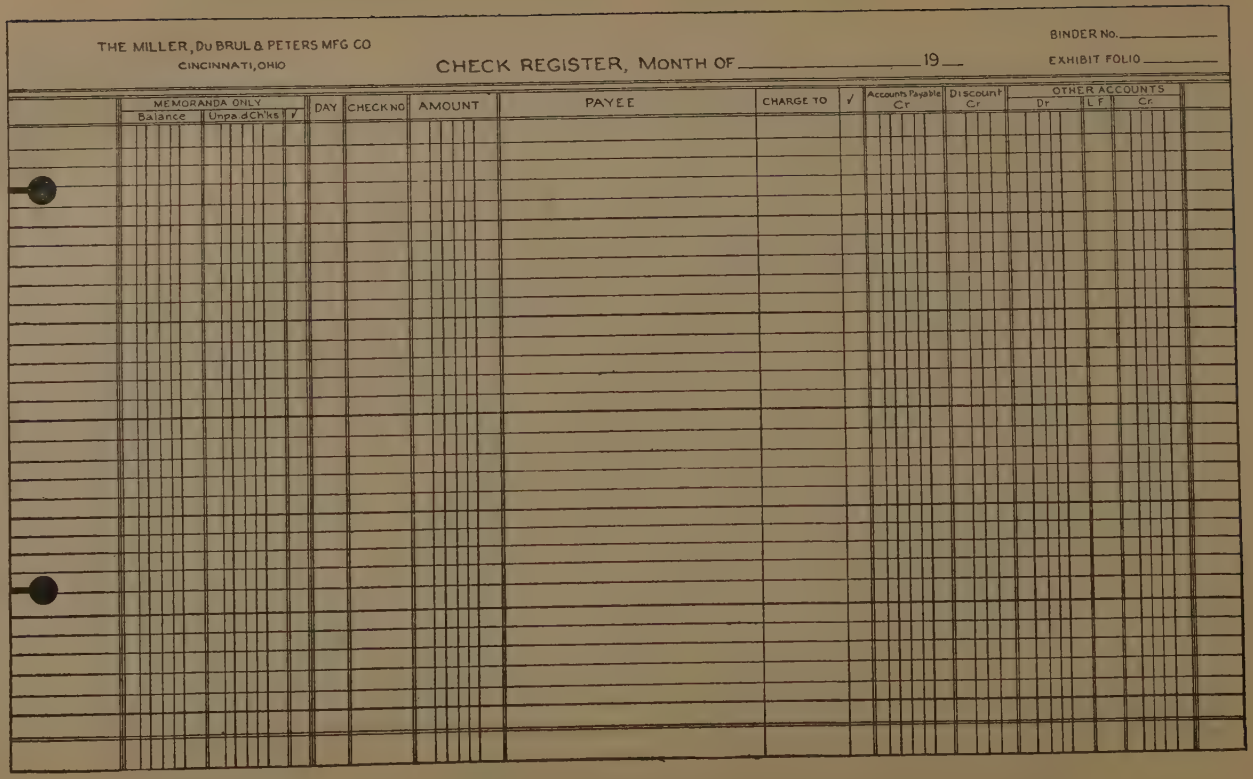


FIG. 219 (Lower). Daily Cash Receipts. (See § 299.) Suggested size, 14"x8½".
FIG. 220 (Upper). Check or Voucher Register. (See § 299.) Suggested size, 14"x8½".

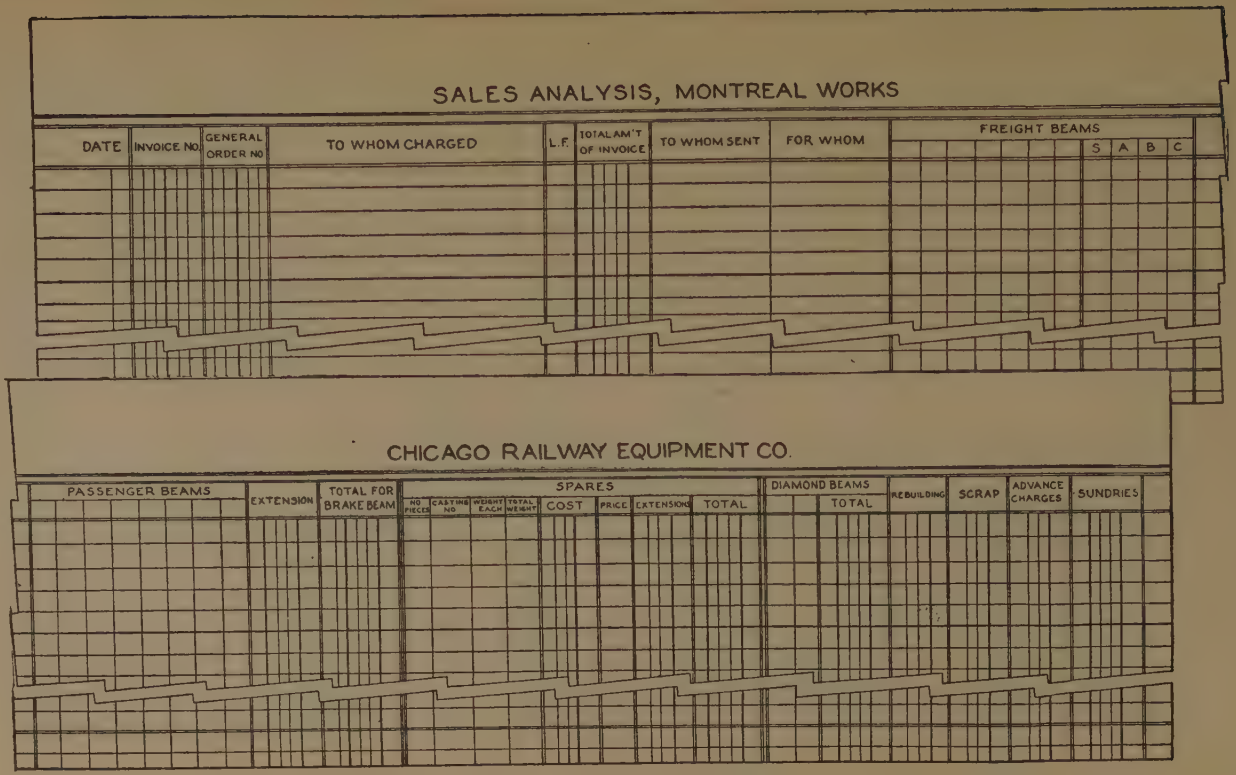

THE MILLER, DU BRUL & PETERS MFG CO
CINCINNATI, OHIO

CHECK REGISTER, MONTH OF _____ 19__

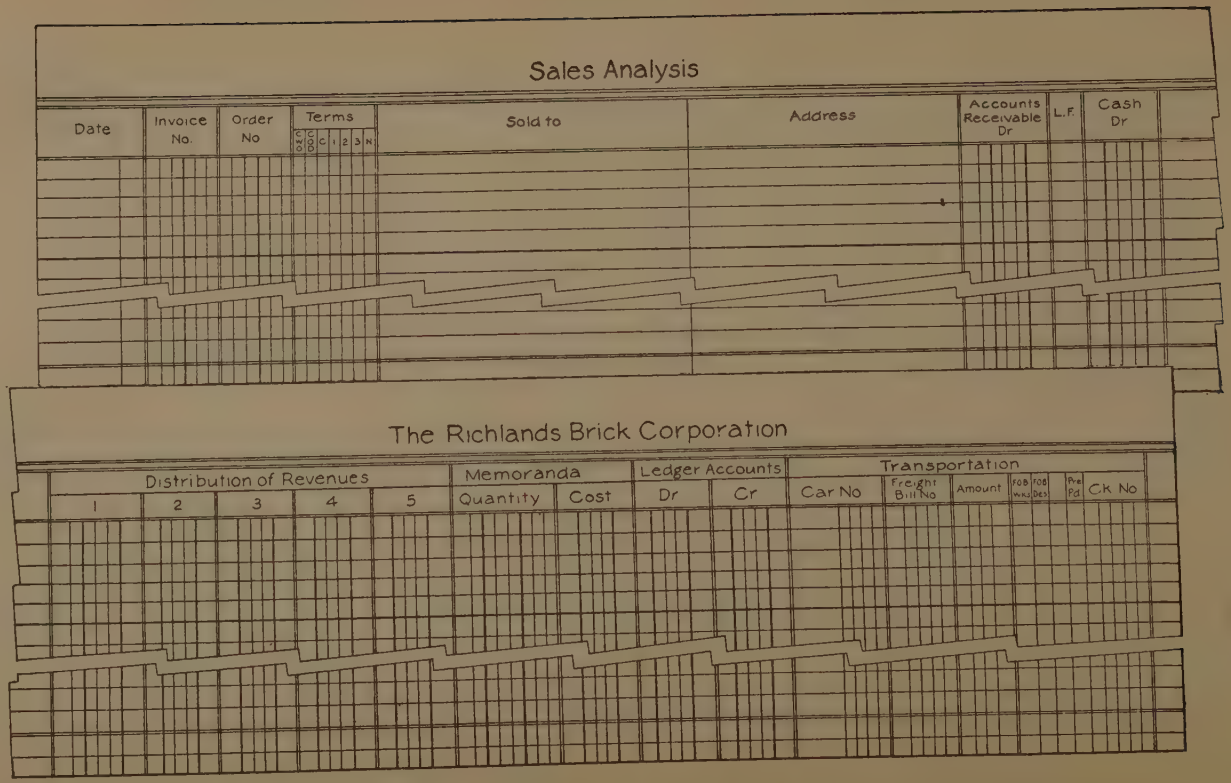
BINDER No. _____
EXHIBIT FOLIO _____

MEMORANDA ONLY			DAY	CHECK NO	AMOUNT	PAYEE	CHARGE TO	✓	Accounts Payable Cr	Discount Cr	OTHER ACCOUNTS		
Balance	Unpaid Ch'ks	✓									Dr	L F	Cr

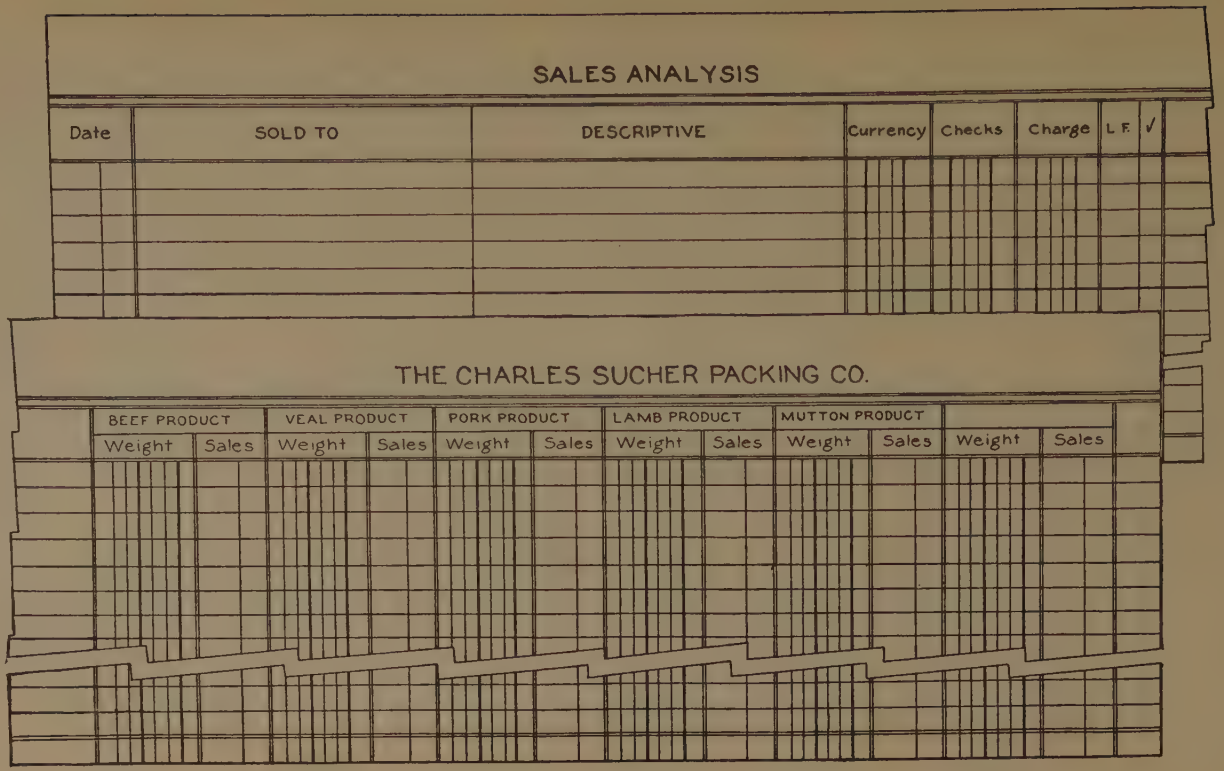
FIG. 221. Check or Voucher Register. (See § 299.) Suggested size, 14"x8½".



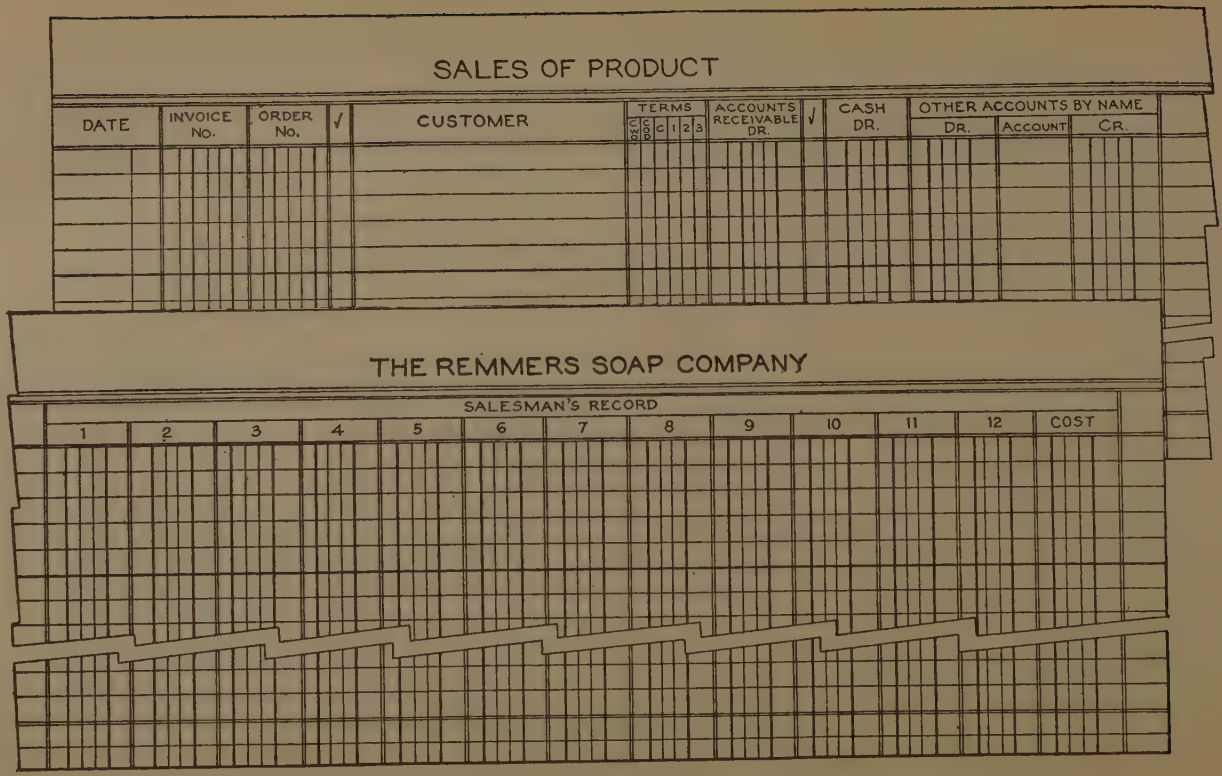
FIGS. 222 (Upper), 223 (Lower). Sales Analysis. Brake Beams. Suggested size, 27"x51 lines.



FIGS. 224 (Upper), 225 (Lower). Sales Analysis. Brick. Suggested size, 22″x51 lines.



FIGS. 226 (Upper), 227 (Lower). Sales Analysis. Packing House. Suggested size, complete form, 18″x51 lines.



FIGS. 228 (Upper), 229 (Lower). Sales Analysis: Soap—Left and Right Halves.
Suggested size, complete form, 22″x51 lines.

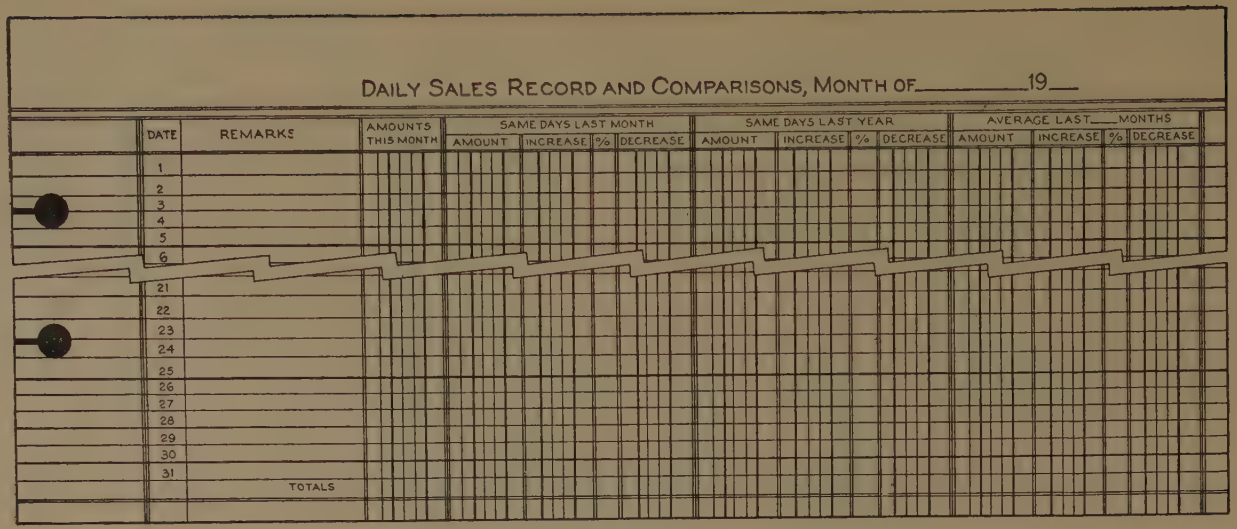


FIG. 230. Daily Sales Statistics and Comparisons. Suggested size, 14"x32 lines.

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FACTORY COSTS *by* WEBNER

Figure 1.

Complete Chart of Accounts

Debit Accounts are in black ink.

Credit Accounts are in red ink.

CAPITALS indicate that synthetical or controlling accounts are to be kept, as explained in Part VII, Chapter XXXIV, preferably on a General Exhibit similar to Figures 204-207.

***Indicates that an analytical ledger or record is to be kept either in a separate book or binder or merely as a sub-division with other records.**

†Indicates that the account is ordinarily kept in a Private or General Ledger.

If chart is to be frequently handled it should be mounted on muslin.

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ANY ORDINARY MANUFACTURING PROPOSITION

BALANCE SHEET

ASSETS — Active

- A
  - 1 Imprest Fund (*Petit cash*)†
  - 2 CURRENT CASH (*Awaiting Deposit*)
  - 3 BANK
  - 4 Notes Receivable†
  - 5 Secured Funds†
  - 6 ACCOUNTS RECEIVABLE* — *See Chapter XXXIV*
- B Store Rooms* — *See Part II*
  - 1 PURCHASED MATERIAL
  - 2 SUPPLIES (*Indirect Material and Expense*)
  - 3 SEMI-FINISHED PRODUCT
  - 4 FINISHED PRODUCT
- C ACCRUING MANUFACTURING EXPENSE* — *See Part IV*
  - *Direct Charges to Production Departments*: 1 Department; 2 Department; 3 Department; 4 Department; 5 Department; 6 Department
  - *Preparation and Supervision*: 7 Plant Factor (a Land, b Buildings); 8 Engineering Department; 9 Purchasing Department; 10 Stores Department; 11 Plant Management; 12 Power Department; 13 Pattern Department; 14 Time and Cost Department
  - *Indirect Labor known generally as Non-productive*: 15 Tool Making and Repairing; 16 Inspectors; 17 Carpenters; 18 Painters (*Where not directly applied.*); 19 Millwrights; 20 Porters and Messengers; 21 Truckers; 22 Elevator Men
  - 23 Fuel other than for Main Power Plant
  - 24 Taxes other than on Plant
  - 25 Insurance other than on Plant
  - 26 Water
  - 27 Light
  - 28 Oil and Waste
  - 29 Factory Supplies, *when not specifically applied to Departments*
  - 30 Technical Library
  - 31 Association Costs
  - 32 Experimental Work
  - 33 Incoming Transportation Charges, *when not absorbed through Stores*
  - 34 Over, Short and Damage, *on orders in Process*
  - 35 Variation of Weights and Measures, *on Stores*
  - 36 Factor of Safety
  - 37 Miscellaneous Manufacturing Expense
  - 38 Maintenance (*where various Factors like Plant, Power, Machine Time, Etc., are used, these costs are applied thereunder*): a Factory Buildings; b Power Plant; c Electric Plant; d Shafting, Hangers and Belting; e Machine Tools; f Small Tools; g Jigs and Templates; h Shop Furniture and Fixtures; i Patterns; j Miscellaneous Shop Equipment
  - 39 Depreciation and Obsolesence (*Where various Factors like Plant, Power, Machine Time, etc. are used these costs are applied thereunder.*): a Factory Buildings; b Power Plant (1 Engines, 2 Boilers); c Electric Plant (3 Generators); d Shafting, Hangers and Belting; e Machine Tools; f Jigs and Templates; g Shop Furniture and Fixtures; h Air System (1 Compressors, 2 Pipes and Fitting); i General Equipment not Specified.
  - 40 Pro-rata of administrative costs: a Office Expense; b Executive Salaries and Expense; c Interest (1 On Investment, 2 On Borrowed Money); d Postage; e Law Expense; f Telegraph and Telephone; g Printing and Stationery; h Subscriptions and Donations; i Experimental — *ANALYZED in manner explained in Chapters XI to XVI inclusive*; *SEGREGATED over Departments in manner explained in Chapter XVII*; *DIFFUSED over Product in the form of a Departmental burden under one of the general plans explained in Chapter XVIII*
- D GOODS IN PROCESS* — *See Part V*
  - 1 Department: a Process; b Material; c Labor; d Expense
  - 2 Department: a Process; b Material; c Labor; d Expense
  - 3 Department: a Process; b Material; c Labor; d Expense
  - 4 Department: a Process; b Material; c Labor; d Expense
  - 5 Department: a Process; b Material; c Labor; d Expense
  - 6 Department: a Process; b Material; c Labor; d Expense

  a Semi-Finished Product subsequently used in the same or succeeding Departments; *b Raw Material*; *c Direct Labor* (*(1) Time Work*; *(2) Piece Work*; *(3) Premium Wages*; *(4) Bonuses*); *d Manufacturing Expense, diffused from Passive Assets group C*
- E EQUIPMENT* — *The nomenclature used will be in accordance with the nature of the specific business under consideration*
  - 1 Machinery and Equipment
  - 2 Small Tools
  - 3 Horses, Wagons and Harness
  - 4 Patterns
- F Fixed
  - 1 Real Estate
  - 2 Buildings
- G Representative
  - 1 Patents
  - 2 Goodwill
- H Negative
  - SUSPENSE* — *See §95*
    - 1 Insurance items paid in advance
    - 2 Interest charges paid in advance
    - 3 Other unaccrued items paid in advance

LIABILITIES — Passive

- I Bonded
  - 1 First Mortgage Bonds
  - 2 Debentures
- J Floating
  - 1 Notes Payable†
  - 2 ACCOUNTS PAYABLE*
  - 3 ACCRUED LABOR*
- K Negative
  - RESERVES* — *See §96*
    - 1 Taxes
    - 2 Interest
    - 3 Experimental
    - 4 Over, Short and Damage
    - 5 Variation of Weights and Measures
    - 6 Factor of Safety
    - 7 Maintenance, *same classification as C38*
    - 8 Depreciation, *same classification as C39*
    - 9 Sinking Fund
    - 10 Bad Debts
- L Capital
  - 1 Monthly (or Four Weekly), Loss and Gain
  - 2 General Loss and Gain
  - 3 Capital Stock (or Investment)
  - 4 Impairment and Surplus

LOSS AND GAIN

- X ACCRUING COMMERCIAL COSTS* — *The nomenclature used will be in accordance with the nature of the specific business under consideration*
  - 1 Commission
  - 2 Commercial Agency Costs
  - 3 Discount Allowed
  - 4 Allowance for Bad Debts
  - 5 Advertising
  - 6 Drayage Outbound
  - 7 Pro-Rata of Administrative Costs, (*as shown under C40*)
- Y PRODUCTION COST OF GOODS DISPOSED OF† (*Optional whether kept in General Exhibit or not*)* — *For Analytical Records see Figures 139-140, 187-188*
- Z REVENUES*
  - 1 Sales of Raw Material
  - 2 Sales of Product
  - 3 Sales of Semi-Finished Product (*Spares or Repair Parts*)
  - 4 Discounting Purchases
  - 5 Interest on Investment
  - 6 Other Sources

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